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NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

29828 (ANL-6971) BIOLOGICAL AND MEDICAL RESEARCH DIVISION ANNUAL REPORT, 1964. (Argonne National Lab., Ill.). Dec. 1964. Contract W-31-109-eng-38. 230p. Dep.; $6.00(cy), 4(mn) CFSTI.

Separate abstracts were prepared for 15 sections of this report. (C.H.)

For abstracts of individual sections see: 29829, 29830, 29849, 29850, 29886, 29887, 29888, 29889, 29890, 29891, 29892, 29893, 29894, 29994, and 30400.

29829 (ANL-6971(p.89)) EPIDEMIOLOGICAL STUDIES IN HUMAN POPULATIONS. (Argonne National Lab., Ill.).

The design is described of an epidemiological study of the relation between neonatal death and the presence of uranium ore reserves, taken as an indication of high environmental radiation level, in the population of Colorado. Data from birth certificates and death certificates were recorded on punch cards and programmed on the IBM 704 computer for analysis of the relationships of interest. No significant correlations were found between infant death rate and terrestrial radiation. A direct correlation between the neonatal death rates and altitude as well as an inverse correlation between average birth weight and altitude was found. Evaluation of available experimental and clinical data indicated the decreased oxygen partial pressure associated with altitude was the underlying factor involved. (C.H.)

29830 (ANL-6971(p.159-65)) ANIMAL FACILITIES OPERATIONS. (Argonne National Lab., Ill.).

The disease control program for all breeding, stock, and experimental animals is discussed. Mouse and rat colonies are monitored for Pseudomonas aeruginosa, Salmonella sp., Citrobacter freundii, Pasteurella Pneumotropica, Mycoplasma sp. and internal and external parasites. The cause of hemorrhagic diathesis in laboratory rodents was investigated. The health of the dog colony is reviewed and the feeding program is discussed. An animal vital statistics program utilizing computer systems for data recording and processing is described. (C.H.)

29831 (CEA-R-2714) CONDITIONNEMENT DES PRIMATES POUR L'EXPERIMENTATION. (Conditioning of Primates for Experimentation). Legeay, Bernard; Geneste, Michel; Brawers, Guy (Commissariat à l'Énergie Atomique, Fontenay-aux-Roses (France). Centre d'Études Nucléaires). Mar. 1965. 35p. Dep.(mn).

The care and feeding of monkeys for experiments is discussed. The construction of a monkey-house, the hygiene rules necessary for obtaining subjects with relatively stable biological parameters are described. This hygiene includes prophylactic treatment, because the animals lived originally in the wild state; a balanced diet, following modern dietetic standards; and a habitat which recreates the original living conditions of the species. The rate of reproduction was used as a criterion of the efficiency of the methods applied. (tr-auth)

29832 (UR-664) EFFECT OF LIPOPOLYSACCHARIDE FROM S. MARCESCENS ON MURPHY-STURM RAT LYMPHOSARCOMAS. Ma. de los Angeles Contreras (Rochester Univ., N. Y. Atomic Energy Project). Mar. 9, 1965. Contract W-7405-eng-49. 24p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

Parallel studies of tumor growth and of ^{131}I-labeled antifibrin antibody localization were carried out in rats bearing Murphy-Sturm tumors. The rats were either untreated, treated with endotoxin (Lipopolysaccharide, S. marcescens), or with this agent plus BAL. Endotoxin doses below the lethal range administered to rats six days after tumor transplant produced a substantial per cent of permanent tumor regressions. BAL was without significant added effect. That immunological processes were important aids to endotoxin in producing permanent tumor regression is indicated by the facts that viable tumor cells by histological criteria seemed still present three days after endotoxin treatment, and that further transplants of this tumor did not grow progressively in animals previously cured by endotoxin injection. The suggestion is made that in instances where human cancer treatment with Coley's toxins and similar agents has been successful, some immune response of the patient may have aided in achieving tumor regression. In untreated rats deposition of ^{131}I, administered as ^{131}I antibody to rat fibrin, took place throughout the tumor in greatest amount at boundary regions between masses of tumor cells and what appeared to be immature connective tissue. In rats treated with endotoxin and injected with radioactive antibody one or two days later, deposition of radioactivity was usually confined to peripheral areas of the tumor which by histological criteria were the locations of viable tumor cells. (auth)

29833 (JPRS-29112) HERALD OF MOSCOW UNIVERSITY. Translations from Vestn. Mosk. Univ., Ser. VI: Biol., Pochvoved., No. 1, 3-8; 74-80(Jan.-Feb); No. 6, 15-25; 39-45(Nov.-Dec. 1964). 48p. (TT-65-30508). $2.00(CFSTI).

An abstract was prepared on one article. Other articles discuss soil-plant relations and the biology of Sakhalin salmon in Soviet rivers. (C.H.)

For an abstract of the individual section see: 29905.

29834 (JPRS-29411) MEDICAL RADIOLOGY. Volume X, Number 1, 1965. Translations from Med. Radiol., 10: No. 1, 39-42; 65-9(1965). 16p. (TT-65-30642). $1.00(CFSTI).

A separate abstract was prepared for one article. The other article discusses developments in medical radiology in the USSR. (C.H.)

For an abstract of the individual section see: 29855.

29835 (JPRS-29912) PROBLEMS OF NUTRITION. Translations from Vopr. Pitaniya, 24: No. 1, 16-24; 31-7 (1965). 26p. (TT-65-30901). $2.00(CFSTI).

An abstract was prepared for one article. Other articles discuss the use of luminescent microscopy for the identification of Salmonellae, and cancerogenic hydrocarbons in smoked sausage and fish products. (C.H.)

For an abstract of the individual paper see: 30600.

29836 METHOD OF PRODUCING LABELED PROTEIN BY MEANS OF RADIOACTIVE ISOTOPES OF SILVER. K. Kolchakov and L. Venkov (Higher Medical Inst., Sofia). Compt. Rend. Acad. Bulgare Sci., 18: 219-22(1965).

In order to avoid some of the defects of iodized protein, a method was worked out for marking protein substances with radioactive isotopes on silver. ^{110}Ag and ^{111}Ag proved to be most suitable for the purpose. The former, which has a half life of 270 days, is advisable for tests in vitro and with animals, while the latter with a half life of 7.6 days may be used for clinical purposes. The method used is described. Protein marked with ^{110}Ag is characterized by a low content of free and weakly bound silver cations. With electrophoresis in agar-gel, it moves at the same rate as the non-labeled protein. (P.C.H.)

29837 AN ANALYSIS OF HOST AND DONOR CONTRIBUTIONS TO SPLENIC ENLARGEMENT IN CHICK EMBRYOS INOCULATED WITH ADULT CHICKEN SPLEEN CELLS. Frank Seto and J. F. Albright (Oak Ridge National Lab., Tenn.). Develop. Biol., 11: 1-24(Jan. 1965).

Studies were conducted to determine quantitatively the effects of donor cell number, host embryo age, and x irradiation of host and donor cells on the expression of splenomegaly. In addition, spleen cell counts, tritiated thymidine (^{3}H-TdR) labeling experiments, and differential cell counts were made to analyze the cellular dynamics of the splenic response. Within the range of embryo ages studied, a fourfold increase in donor cell number resulted in an approximate doubling of the plateau level of spleen weight. The relation between donor cell number and splenic enlargement is suggestive of an antigen dosage effect, where either donor cells or host embryo is considered as antigen. The max splenic enlargement resulting from injection of the max permissible number of donor cells varied with the age of the recipient embryo, being minimal in 8- to 10-day-old hosts, maximal in 12- to 13-day-old hosts, and declining in older embryos. Irradiation of either donor spleen cells or recipient embryos prior to inoculation was equally effective in reducing splenic enlargement, and the decrease was radiation-dose dependent. The predominant spleen cell type present during peak splenic enlargement is the blast cell, and it increases in number at a faster rate than do other cell types during enlargement of the spleen. A calculation, based on the number of ^{3}H-TdR-labeled donor spleen cells which settle in the spleen initially and proliferate, indicates that the number is too small to account for the splenic enlargement. The activation of the reservoir of host proliferative cells, however, can easily account for the observed enlargement. The results indicate that both host embryos and grafted adult spleen cells participate in the splenic enlargement. (BBB)

29838 GERMINAL CENTER CHANGES AND PLASMA CELL REACTION DURING THE PRIMARY IMMUNE RESPONSE. M. G. Hanna, Jr. (Oak Ridge National Lab., Tenn.). Intern. Arch. Allergy Appl. Immunol., 26: 230-51(1965).

Histologic and autoradiographic investigations were performed on the lymphatic tissue of the mouse spleen during the first 4 days after a primary sheep red blood cell (SRBC) stimulation. Germinal center cells in the lymphatic tissue responded to antigenic stimulation by proliferation which was detected in two ways: (1) within intact germinal centers (hyperplasia), and (2) in a dispersed manner with migration. Both of these responses are considered characteristic of the inductive phase of the primary immune response. An increase in germinal center volume and number of countable centers per longitudinal section occurred 2 hr after SRBC-injection, followed by a rapid decrease in both parameters over the next 22 hr. A recovery in both germinal center volume and number occurred between days 1 and 4 following injection. At day 4, a fourfold increase in germinal center volume was measured in the antigen stimulated group. In the SRBC-stimulated animals the increase in number of large pyronine-stained cells in the lymphocyte mass coincided closely with germinal center dissociation. Topographically, the time sequence of the increase in number of pyronine-stained cells was first in the area of the germinal center, second in the edema-like region of the lymphatic nodule, and third in the red pulp of the spleen. Coinciding with the increased number of pyronine-stained cells in the spleen red pulp was the formation of foci of plasma cells in which active plasmacytopoiesis could be observed. The fate of large pyronine-stained cells during early intervals of the primary immune response was studied with spleen imprint autoradiograms. These studies suggested that the pyronine-stained cells of the dissociated germinal centers were precursors of immature plasma cells, the transformation beginning between days 1 and 2 after antigen injection. (auth)

29839 A NEW TYPE OF RESPIROMETER. M. Hribar (Nuclear Inst. "Josef Stefan," Ljubljana, Yugoslavia). Intern. J. Appl. Radiation Isotopes, 16: 341(May 1965).

A respirometer was developed using the method of continuous ionization. The diameter of the tube is 2 cm and the isotope used is ^{210}Pb. To improve linearity two sources were used instead of one; the linearity was better than 5% of the range from 2 to 60 l/min. (M.C.G.)

29840 ENDOTOXEMIA AND ADRENAL HEMORRHAGE. A MECHANISM FOR THE WATERHOUSE-FRIDERICHSEN SYNDROME. Jack Levin and Leighton E. Cluff (Johns Hopkins Univ. School of Medicine, Baltimore). J. Exptl. Med. 121: 247-60(Feb. 1, 1965).

An experimental model that produces adrenal cortical hemorrhage with endotoxin has been described. When stimulated by Thorotrast, endotoxin, or its tropic hormone (ACTH), the adrenal cortex is susceptible to the development of a hemorrhagic reaction during endotoxemia. The hemorrhagic reaction resembles that described in the Waterhouse-Friderichsen syndrome. A pathophysiologic mechanism for the occurrence of adrenal hemorrhage occurring during acute sepsis is presented. Increased metabolic activity associated with the production of corticosteroids seems to make the adrenal cortex susceptible to endotoxin-induced hemorrhage. Adrenal hemorrhage observed during sepsis, as in the Waterhouse-Friderichsen syndrome, may be attributable to endotoxemia occurring during or shortly after stimulation of the adrenal cortex by infection. The cortisol levels of blood were the same after administration of Thorotrast, endotoxin, or ACTH, but the hemorrhagic cortical reaction to endotoxin was often most intense after preparation with Thorotrast. Thorotrast may have this effect because it not only stimulates the adrenal cortex but increases the injurious effects of endotoxin by interference with reticuloendothelial function. (BBB)

29841 RESULTS OF STUDY OF THE BIOLOGICAL EFFECTIVENESS OF A NUMBER OF SPACE-FLIGHT FACTORS. V. V. Parin, V. V. Antipov, B. I. Davydov, E. F. Panchenkova, G. A. Chernov, and A. I. Nesterenko. Kosmich. Issled., 3: 315-24(Mar.-Apr. 1965). (In Russian)

Experimental data on the biological effectiveness of a number of factors in space flight (vibration, acceleration, ionizing radiation, and the combined action of radiation with dynamic space-flight factors), as evaluated from the changes in the serotonin and ceruloplasmin contents in the blood of mice, rats, guinea pigs, dogs, and monkeys, are presented. The results obtained indicate that these methods are sensitive in evaluating the reactivity state of the animals subject to space-flight factors. (tr-auth)

29842 ASSESSMENT OF RADIOACTIVITY IN MAN. VOL. I. Proceedings of the Symposium Held at Heidelberg, 11-16 May 1964. (International Atomic Energy Agency, Vienna). Proceedings Series. Oct. 1964. 401p.

(STI/PUB/84(Vol.I); CONF-448(Vol.I)). $8.00; S 168.-; £ 2.80; F.Fr. 32.-; DM 28.-(IAEA).

Twenty-two papers were presented on in vivo counting, bioassay, and interpretation of data; separate abstracts were prepared for ten. Abstracts of the remaining twelve appear in NSA 18: 17722, 33264, 33266, 33428, 33518, 33677, 33819, 35301, 35407, 35489, 37100, and 43318. (H.G.D.)

For abstracts of individual papers see: 29879, 29880, 30140, 30473, 30474, 30580, 30581, 30582, 30583, and 30584.

29843 PUBLIC HEALTH AND THE MEDICAL USE OF IONIZING RADIATION. Fifth Report of the WHO Expert Committee on Radiation. World Health Organization Technical Report Series No. 306. Geneva, World Health Organization, 1965. 41p. Also Published in French and Spanish. 5/-; $1.00; Sw. fr. 3.-.

The WHO Expert Committee on Radiation considered the problems relating to the efficient and safe uses of ionizing radiation in medicine, taking into account the possible somatic and genetic risks associated with the doses at present delivered during the radiodiagnosis and radiotherapy. The Committee studied the methods available for reducing doses during radiological examinations and emphasized that these doses can very often be considerably lowered without diminishing the amount of medical information provided. A similar conclusion was reached with regard to the diagnostic uses of radioisotopes. In radiotherapy also, especially the radiotherapy of benign conditions, a substantial reduction of population dose can be achieved by careful selection of patients and by a constant preoccupation with the safeguarding of healthy tissue. The Committee also considered the responsibility of the public health authorities for giving due attention to the benefits and risks of the medical use of ionizing radiation and for taking all measures required to obtain the maximum benefit with the minimum of risk. Finally, the Committee reviewed different aspects of the training of medical and paramedical personnel and concluded that education and research were essential elements in achieving the best use of ionizing radiation for medical purposes. (auth)

Ecology

29844 DISPERSAL OF RELEASED IRRADIATED LABORATORY-REARED SCREW-WORM FLIES. B. G. Hightower, A. L. Adams, and D. A. Alley (Dept. of Agriculture, Mission, Tex.). J. Econ. Entomol., 58: 373-4(Apr. 1965).

An extensive screw-worm survey has been carried on in Texas since 1962 in conjunction with a large-scale eradication program. Long-range dispersal by gravid female flies was investigated in trapping studies with marked, irradiated lab-reared flies. About 200,000 irradiated flies, marked with red or blue dye, were released at weekly intervals from April 25 to November 15, 1963. Recovered marked flies could be associated with a particular release by dye color until multiple releases with both colors had been made. Traps were placed near the Colorado River at 10-mile intervals beginning 10 miles northwest of the initial release point. Other traps were situated in west-central Texas, in the rolling plains area, and along the Concho River beginning 10 miles west of its confluence with the Colorado River. Trapping records on marked irradiated lab-reared screw-worm flies indicated a maximum dispersal range of 180 mi for individual flies of this species. Reference of recovered flies to identifiable dates of release indicated these distances may be covered in less than 2 weeks. Discounting the expected decrease in density of released flies as a function of distance from the release point and assuming some degree of channeling of dispersal, it is probable that the more distant catches represented a small portion of the marked population. Assuming this dispersal pattern is independent of population density, these far-ranging individuals would have to be considered in large-scale control operations. (TCO)

29845 CONTENT OF Ra^{226}, Pm^{147}, AND Mn^{54} IN PLANKTON SAMPLES OF THE TYRRHENIAN SEA. Enrico Cerrai, Bruno Schreiber, Cesare Triulzi, and Laura Tassi-Pelati (Centro Informazioni Studi Esperienze, Milan). Rend. Ist. Lombardo Sci Lettere, B, 98: 197-204 (1964). (In Italian)

Radiochemical analysis allowed the determination of concentration of ^{147}Pm in plankton and sea water samples collected in the Tyrrenian Sea. The content of ^{226}Ra and ^{54}Mn was also determined in plankton. The ratio $^{144}Ce/^{147}Pm$ in plankton and in sea water was also evaluated and that of water compared to the $^{144}Ce/^{90}Sr$ ratio of the same sample. (auth)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstract 30122.

29846 (ACRH-103(p.28-36)) STUDIES IN MOLECULAR BIOLOGY. (Argonne Cancer Research Hospital, Chicago, Ill.).

Brief summaries are presented of research studies in the field of molecular biology. These include studies of hemoglobin synthesis, studies of erythropoietin-induced differentiation, protein synthesis in heart muscle, the synthesis of ribonucleic acid in microorganisms, and the effects of polycyclic aromatic hydrocarbons on the growth of bacteriophage. (C.H.)

29847 (ACRH-103(p.48-61)) STUDIES ON THE BLOOD. (Argonne Cancer Research Hospital, Chicago, Ill.).

Brief summaries are presented of studies on the blood. These include studies of erythropoietin production; the effects of long-term high oxygen pressure in man, mice, and rats; Fe metabolism in man; transport across erythrocyte membranes; studies of lymphocytes from patients with lymphocytic leukemia and lymphosarcoma in tissue cultures; and studies of mouse leukemia viruses. (C.H.)

29848 (ACRH-103(p.62-75)) GENERAL METABOLIC STUDIES. (Argonne Cancer Research Hospital, Chicago, Ill.).

Brief summaries are presented of metabolic studies. These include studies of uric acid metabolism, the use of ^{99}Mo for scintillation scanning of the liver, steroid metabolism and pharmacology, the effects of radiation on carbohydrate metabolism in rats, tracer studies of carbohydrate metabolism, tracer studies of Ca metabolism in man using ^{47}Ca and whole-body counting, the metabolism of ^{85}Sr and ^{137}Cs in man, tracer studies of Mg in rats using ^{28}Mg, and metabolism in human skin. (C.H.)

29849 (ANL-6971(p.1-28)) BIOCHEMISTRY. (Argonne National Lab., Ill.).

Progress is reported in various biochemical studies. Topics discussed include the relation between cytology and physiological function of the yeasts Saccharomyces cerevisiae and Candida utilis; the effects of the quantity and properties of certain nuclear proteins on the metabolic status of rat liver cells; the stability of the secondary structure of nucleic acids; the breeding of mice deficient in certain specific metabolic factors; the effects of puromycin on erythrocyte catalase; the toxicity of tritiated thymidine and other tritiated precursors of DNA, RNA, and proteins; the synthesis of cholesterol in rat liver; the use of dual tracer techniques in chromatographic studies of sterol metabolism; the biochemical basis for the transformation of cartilage to bone; the functional and control mechanisms of lysosomes and the effects of x radiation on lysosomes in rat thymus and liver; the use of labeled precursors to investigate the enzymatic conversion of 5′-methylthioadenosine and 5-adenosylmethionine in Candida utilis; tracer studies of methionine synthesis in Saccharomyces cerevisiae and Aerobacter aerogenes; applications of ultraviolet microscopy in cytological and biochemical studies on Saccharomyces cerevisiae; the metabolism of mitochondrial proteins in normal and x irradiated rats; the effects of deuterium isotopes on lactate dehydrogenase and glucose

transport in skeletal muscles, heart muscles, and physiological systems of mice and rats; and the synthesis of propionic acid by Propionibacterium shermanii. (C.H.)

29850 (ANL-6971(p.133-42)) METABOLISM OF FISSION PRODUCTS. (Argonne National Lab., Ill.).

Progress is reported in studies of the metabolism of fission products. Data are presented on the toxic effects of intravenously injected ^{137}Cs on ^{144}Ce in dogs of different ages and the response of dogs to continuous exposure to ^{60}Co γ radiation at doses estimated to be from 50 to 300 R. Emphasis was placed on effects on the hematopoietic system. The life-span of erythrocytes in beagles was determined to be about 80 days by ^{59}Fe tracer methods. (C.H.)

29851 (CEA-R-2727) ETUDE SUR L'INTERPRETATION DES MESURES D'IODE 132 DANS L'ORGANISME APRES INHALATION DE TELLURE 132. (Study of the Interpretation of Iodine-132 Measurements in the Organism After Inhalation of Tellurium-132). Merchali, David; Dousset, Marc; Vial, Renee; Odievre-Penotet, Monique (Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre de Études Nucléaires). Mar. 1965. 15p. Dep.(mn).

An attempt was made to define the evolution with time of the tellurium-132 and iodine-132 distributions in the organism after a single inhalation of tellurium-132. The ratio of the activities of extra-thyroidal iodine-132 to thyroidal iodine-132 varies initially with time and only becomes constant after 36 hours. It is possible to deduce from the iodine-132 activity measured in the thyroid or in the whole organism the amount of tellurium-132 inhaled and the doses which result. Because of the uncertainty in the transmission kinetics across the inlet passages however, greater value should be attached to the measurements made at a moment when their results are independent of these kinetics, preferably after 36 hours. (tr-auth)

29852 (CONF-650614-1) TRANSLOCATION OF IRON IN PLANTS. A. Wallace and P. C. DeKock (California Univ., Los Angeles. Dept. of Agricultural Sciences). [1964]. Contract AT(11-1)-34. 6p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Symposium on the use of Isotopes and Radiation in Soil-Plant Nutrition, Ankara.

Data are reviewed from studies of iron chlorosis in plants in which ^{59}Fe was used as a tracer. Results are reported from studies of the effects of plant species, phosphorus content of the nutrient solution, effects of heavy metals, and the effects of Fe chelates on the translocation of Fe in citrus fruits, tobacco, and soybeans. (C.H.)

29853 (IA-715) THE EFFECT OF CERTAIN METALLIC CATIONS ON THE FORMATION AND DEIODINATION OF THYROXINE IN MICE. M. Anbar and M. Inbar (Israel Atomic Energy Commission, Yavne. Soreq Research Establishment). Dec. 1964. 21p. Dep.(mn).

Ferric, cupric, mercuric, zinc, cadmium and nickel ions at a dose level of 0.1 millimole per kg body weight were found to decrease the uptake of iodine in the thyroid gland. Manganous ions exhibited a similar effect when the dose was doubled. A parallel decrease in the BF_4^- uptake was demonstrated; this suggests an interference at the trapping stage. The cations mentioned, except nickel, were found to enhance the rate of deiodination of thyroxine. Cobaltous, cobaltic, manganous, magnesium, beryllium and zirconium ions were shown to have no effect on iodine uptake at the same dose level. Cobaltous ions, however, were found to inhibit the deiodination of thyroxine. The mechanism of the deiodination reaction is discussed. It is suggested that it involves a single electron transfer process which is regulated by the intracellular RSH concentration. (auth)

29854 (TID-21859) STEROID HORMONES IN RELATION TO IRRADIATION. Progress Report, 1950-1963. Ralph I. Dorfman (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Feb. 15, 1963. Contract AT(30-1)-918. 72p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Fifty-four ^{14}C and ^{3}H labeled steroids were synthesized for use in a variety of metabolic and micro-analytical studies. Procedures are described for the determination of steroid and protein hormones in body fluids and the isolation of steroids in biological fluids. Data are presented from studies of the metabolism of steroid hormones and enzymes; the metabolism of various steroids in tissues and body fluids of normal men and women, pregnant women, and individuals with various pathological conditions; the determination of steroids in human fetal adrenals; and the effects of x radiation on the content of steroids in the urine of guinea pigs. (88 references.) (C.H.)

29855 (JPRS-29411(p.1-7)) TOXICOLOGY OF RADIOSULFUR (S^{35}). N. M. Oganesyan. Translated from Med. Radiol., 10: No. 1, 39-42(1965).

Parameters of the toxicity of ^{35}S for mice were found to be as follows: a minimum lethal dose, 15 mc/kg; $LD_{50/30}$, 29 mc/kg; and LD_{100}, 40 mc/kg; for rats the values were 20, 31, and 45 mc/kg, respectively. Luminescent-microscopic changes were revealed in the blood half-an-hour after ^{35}S uptake by the organism and were proportional to the irradiation dose. Upon administration of ^{35}S in the amount of 72 μc/kg, 5, and 15 mc/kg, there occurred in the blood a decrease of the content of hemoglobin, erythrocytes, and reticulocytes, and neutrophils, eosinophilia, and thrombocytopenia. (auth)

29856 METHODOLOGICAL REMARKS ON SAPIRSTEIN'S ISOTOPE INDICATOR FRACTIONATION TECHNIQUE. L. Takacs, K. Kallay, and A. Karai (Univ. Medical School, Budapest). Acta Physiol. Acad. Sci. Hung., 25: 389-98(1964).

An attempt was made to elucidate some problems connected with Sapirstein's isotope indicator fractionation technique. In order to achieve results in which less than ten per cent of the intravenously administered ^{86}Rb and ^{42}K is present in the blood, 60 seconds have to elapse in the case of normal rats, 120 seconds in the case of exsanguinated rats (with a blood pressure of 20 mmHg) and 120 seconds in the case of normal dogs. In the dog, at least 30% of the intravenously administered ^{86}Rb is taken up by the lungs through the pulmonary artery. In the dog, ^{86}Rb concentration in the portal bed amounts to 18% of that found in arterial blood. (auth)

29857 BERYLLIUM, 1964-TOXICITY AND HANDLING. Harry M. Donaldson (Brush Beryllium Co., Elmore, Ohio). Arch. Environ. Health, 10: 554-9(Apr. 1965).

The development of protective measures in the Be-processing industry is reviewed with illustrative examples provided by measures employed at the Lorain (Ohio) and Elmore (Ohio) refineries operated by this company. In 1942, at the plant in Lorain, in addition to the usual dermatological problems, acute pulmonary effects (tracheobronchitis and chemical pneumonitis) appeared. At this time the hazards of Be were not fully known. In the late 1940's, people living in the vicinity of the Lorain plant began to develop a respiratory illness, and the same phenomenon was noticed in and around fluorescent lamp plants using BeO in phosphors. At this time, the Atomic Energy Commission (the largest customer for beryllium) and the Ohio Department of Health became concerned with this health problem, and as a result of the illness around the Lorain refinery, a causal relation was established between airborne Be exposure and this illness, chronic berylliosis. In the early period, fumes containing BeF_2, $BeSO_4$, BeO, along with known irritants, such as SO_2, SO_3, and F^- fumes were heavy enough at times to obscure vision throughout the plant. Uncontrolled operations at the Lorain plant and Cleveland facilities from the late 1930's through 1949 resulted in 22 inplant and 18 outplant cases of chronic berylliosis, although the disease never appeared in an active employee. All inplant cases were the result of short-term exposures, from a minimum of 66 hr to a maximum of about 1000 hr. The incidence rate at the Lorain refinery was about 1%, which was lower than that experienced in the fluorescent lamp industry, where the incidence rate

was about 3%. Illustrations show the environmental conditions and handling procedures at the Lorain refinery, compared with present day conditions at the Elmore refinery. Protective measures instituted included hooding and local exhaust ventilation, installing process equipment that can be ventilated or controlled, and educating plant employees in hygienic work practices. Controls and technology in Be processing have advanced, but potential toxicity problems are still present. Potential dermatitis still exists when skin contact is made with soluble Be salts, principally the fluoride. Accidental exposure to fumes of BeF_2 may result in chemical pneumonitis. No disabling cases of chronic berylliosis have resulted from exposure since 1949. From 1961 through 1963, four Brush Co. employees developed symptoms of illness ultimately diagnosed as berylliosis. These employees were not engaged in production work where operations can be carefully monitored, but in decontamination and maintenance work where monitoring of exposure is difficult due to the nonrepetitive nature of the work. It is concluded that, with adequate engineering and medical controls, Be in its many forms can be handled safely in large quantities without fear of producing chronic disabling disease. (BBB)

29858 PHARMACOLOGIC EFFECTS ON THYROID ACTIVITY. B. Fischetti (Universita, Rome). Arch. Ital. Sci. Farmacol., 12: 33-77(Jan. 1962). (In Italian)

An extensive review, citing 736 references, is presented covering the effects of drugs on radioiodine incorporation by the thyroid gland as well as other indices of changes in thyroid activity. The problem concerning the relation between iodine metabolism and thyroid activity is considered in relation to the phylogenetic development of endocrine function. The priority of the thyroxinogenesis in the evolution of thyroid activity is stressed and the importance is estimated of the data relating to pharmacological actions selective towards the different stages of thyroxinogenesis in lower organisms (invertebrates, cyclostomes) which have no thyroid gland. Also stressed is the possibility of defining groups of drugs acting selectively on the various stages of thyroxinogenesis, their phylogenetic distribution, and their localization (thyroidal or extrathyroidal sites) in higher organisms. The pituitary-thyroid relation is considered in terms of the possible pharmacological influences on the homeostatic (feed-back) mechanism based on the interactions between the thyroid and the pituitary, depending to a considerable extent upon hypothalamic activity. A general survey is presented on biochemical mechanisms of drugs acting on thyroid function. The following groups are considered: (a) drugs acting on the various steps of thyroid iodine metabolism (including the iodide-concentrating mechanism, conversion of iodide to iodine, iodination of tyrosine yielding monoiodo- and diiodotyrosine, formation of thyroxine and triiodothyronine, proteolysis of thyroglobulin, and release of diffusible hormones); (b) drugs acting on the binding of thyroid hormones to the serum proteins; and (c) drugs which interfere with the metabolic degradation and effects of the thyroid hormones, including compounds related to thyroxine with thyroxine-like and thyroxine-inhibiting properties. Also pointed out is a recent report suggesting an extrathyroid site of action (on the peripheral metabolism of thyroid hormones) even of drugs known to be exclusively thyrotropic (i.e. the thiouracil derivatives). The advantages and limitations of a biochemical classification of drugs acting on thyroidal function are listed. The author's studies examining the effect of various drugs on the ^{131}I uptake of thyroid gland under various conditions are also reviewed. Several psychotropic drugs of the phenothiazine series, used as tranquilizers, were shown to depress thyroid ^{131}I uptake in vitro, and inhibit ^{131}I incorporation into thyroid hormone fractions. (BBB)

29859 EXPERIMENTAL CONTRIBUTION TO THE STUDY OF THE MECHANISM OF THYROID ACTION OF VARIOUS PSYCHOACTIVE DRUGS. RESEARCH CONDUCTED ON THYROID IODINE UPTAKE IN VITRO. B. Fischetti (Universita, Perugia, Italy). Arch. Ital. Sci. Farmacol., 13: 187-9(July 1963). (In Italian)

The influence of various psychotropic drugs on the ^{131}I uptake of the thyroid, and conversion of ^{131}I to the organically bound state, was investigated. Slices (250 mg) of thyroid gland were removed from animals (species not stated) soon after sacrifice and incubated in Ringer-Krebs medium to which was added 0.8 μC of carrier free ^{131}I (as NaI) and various drugs in concentrations of 10^{-5}-10^{-3}M. Homogenates of the slices were obtained after various periods of incubation, and measured for total radioactivity and by paper chromatography for inorganic ^{131}I, protein-bound ^{131}I, monoiodothyronine-^{131}I (MIT), and diiodothyronine-^{131}I (DIT). All the drugs tested (chlorpromazine, perphenazine, triflupromazine, imipramine), as well as propylthiouracil (PTU), at concentrations of 10^{-3}M depressed the in vitro thyroid uptake of ^{131}I. The most active drug, chlorpromazine, showed activity comparable with that of the known thyroid inhibitor PTU. Chlorpromazine was also inhibitory at 10^{-4}M, but the other drugs were not. Depression of ^{131}I thyroid uptake by the drugs was accompanied by decreased incorporation of ^{131}I in the various fractions, including MIT and DIT. When these results are correlated with in vivo studies of the same drugs, it is evident that the phenothiazine derivatives used as tranquilizers, and imipramine, have a direct inhibitory action on the thyroid gland. (BBB)

29860 THE CALIBRATION OF THYROIDAL UPTAKES IN AUSTRALIA. John Myhill (Royal North Shore Hospital, Sydney). Brit. J. Radiol., 38: 465-71(June 1965).

Three mock-iodine manikins, simulating hypothyroid, euthyroid, and hyperthyroid patients, were circulated to interested laboratories in Australia. The true uptake values and the average unsigned errors of the reported measurements (as a percent of true uptake) were 12.4% (12.9), 36% (3.9), and 60% (10.1). It was concluded that Australian euthyroidal uptakes are accurately measured and may be validly compared with those in other parts of the world in international surveys of thyroid function. It appeared that the measurement of both high and low uptakes could be improved. (auth)

29861 RADIOGOLD DISTRIBUTION IN THE BONE MARROW. R. Hoefer and H. Egert (Universitatsklinik, Vienna). Bull. Schweiz. Akad. Med. Wiss., 19: 36-46 (Sept 1963). (In German)

Previous studies on the distribution of injected ^{198}Au in the body, especially in cells of the reticuloendothelial system (RES), are reviewed, and new experiments in patients are reported in which the isotope uptake by bone marrow was detected. The earlier studies showed that colloidal gold is a nearly ideal tracer for the scintigraphic visualization of the liver. Under normal conditions colloidal gold is specifically localized in the RES cells of the liver. The uptake of the colloid by the extrahepatic RES is of minor importance only. Other studies have shown recently that under pathological conditions, such as cirrhosis of the liver, however, the localization of the colloid in the extrahepatic RES, i.e. in the bone marrow, is increased to such an extent that the whole skeleton shows up in the scintigram. It was shown that two mechanisms are responsible for such a pathological distribution of colloidal ^{198}Au: either the liver efficiency for the colloid is abnormally low, and, therefore, the RES of the bone marrow takes up an abnormally high proportion of the injected dose, as in liver cirrhosis; or the colloid clearance of the bone marrow is abnormally high as in polycythemia and leukemia. These findings suggest the possibility that bone marrow uptake of ^{198}Au offers a diagnostic test for diseases of the hematopoietic system. It is also pointed out that altered bone marrow accumulation of ^{198}Au could give erroneous results when the radioisotope is used to measure blood flow in the liver. (BBB)

29862 IN VIVO INCORPORATION OF P^{32} INTO CHICKEN SERUM PHOSPHOLIPIDS. U. K. Misra (Delhi Univ.). Can. J. Biochem., 43: 711-22(June 1965).

Chicken serum phospholipids were separated by means of silicic acid column chromatography into phosphatidyl ethanolamine, lecithin, sphingomyelin and lysolecithin. Their concentration in serum is 12, 68, 10, and 9% respec-

tively of the total of 93.0 mg (average) phospholipid P per 100 ml. The maximum specific activity of serum phospholipids is attained 8 hours after the administration of a dose of inorganic ^{32}P. The rate of ^{32}P incorporation into serum phospholipids, as studied by means of silicic acid column chromatography, is of the following order: phosphatidyl ethanolamine > lecithin > lysolecithin > sphingomelin. Lysophosphatidyl ethanolamine has been isolated from chicken serum by means of silicic acid impregnated paper chromatography. It represents about 4% of total chicken serum phospholipids. It gave a glycerol to phosphorus ratio of 1.0 and fatty acid ester to phosphorus ratio of 1.03. It also showed a strong hemolytic activity on sheep erythrocytes, and its specific activity 8 hours after the injection of inorganic ^{32}P reached about 25% of that for phosphatidyl ethanolamine. (auth)

29863 EFFECT OF pH ON THE FOLIAR RETENTION OF IODINE-131, IN THE CHEMICAL FORMS I_2 AND I^-, IN HELODEA CANADENSIS RICH. R. R. Roncucci and R. J. Kirchmann (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). Compt. Rend. Soc. Biol., 158: 2212-16(1964). (In French)

The effect of pH on the foliar retention of I_2 and I^- in carrier-free buffered solution was investigated using ^{131}I as a tracer. The determination was made at pH 3 to 8. pH does not seem to effect the retention of the biatomic. For I^- the effect of the pH is considerable. The retention increases inversely with the hydrogen ion concentration. The effect of the pH on the iodide absorption from very dilute media is due to a great extent to purely physicochemical phenomena. A slight acidification of the milieu reduces significantly in aquatic vegetation radiocontamination caused by ^{131}I. (J.S.R.)

29864 THE DISTRIBUTION OF THE INHALED SHORT-LIFE DAUGHTER PRODUCTS OF RADON IN THE RESPIRATORY TRACT. V. N. Kirichenko. Gigiena i Sanit., No. 2, 113-16(Feb. 1965). (In Russian)

It is assumed that the radioactive daughter products of radon are carried on aerosols with a radius of 10^{-5}, 10^{-6}, or 10^{-7} cm. A diffusion parameter $\mu = Dx/R^2v$ is defined. Here D is the diffusion coefficient of the particle; R is the radius of the bronchial tube; x is the length of the bronchial tube, and v is the average linear flow velocity. The breathing rate is 12 l/min. The fraction of particles not settling out, η, is the following: at $\mu > 0.01$, $\eta = 0.819 \exp(-3.657\mu) + 0.097 \exp(-22.3\mu)$, and at $\mu < 0.01$, $\eta = 1 - 2.56\mu^{\frac{2}{3}} + 1.2\mu + 0.177\mu^{\frac{4}{3}}$. The simplified model assumes that the respiratory tubes branch out into successive subdivisions. The dose is deposited in a surface layer 56 microns thick (the range of alpha particles from radium A). Data on the number of respiratory tubes, the radii of the tubes, the weight of irradiated tissue, and average air velocity are taken from Findeisen. The calculated dose to the main bronchi exceeds the average dose to the respiratory tract by a factor of 35, and significantly exceeds the allowable radiation dose for internal organs. The distribution of absorbed dose is not uniform, and this inhomogeneity must be taken into account in estimating the biological damage from air that contains radon. (TTT)

29865 METABOLISM OF STRONTIUM IN THE NEWBORN. C. L. Comar, K. Kostial, N. Gruden, and G. E. Harrison (Cornell Univ., Ithaca, N. Y.; Inst. for Medical Research, Zagreb; and Medical Research Council, Harwell, Berks, Eng.). Health Phys. 11: 609-15(July 1965).

Experimental observations on strontium metabolism in the newborn rat and man can be explained by the following concept: the Sr/Ca ratio of the infant bone existing at birth as well as that of new bone being formed assumes a value that is determined by the Sr/Ca of the infant's diet and the degree of discrimination operative. The infant can lose or gain Sr from the body depending upon the rate of growth and the comparative Sr/Ca ratios of the body at birth and of the diet. These factors are such that the breast-fed human infant is likely to lose strontium from the body in the early days and weeks after birth. (auth)

29866 DISTRIBUTION OF ^{226}Ra BETWEEN BLOOD CELLS AND PLASMA. Betsy J. Stover, D. R. Atherton, F. W. Bruenger, and C. W. Mays (Univ. of Utah, Salt Lake City). Health Phys., 11: 617-22(July 1965).

The concentration of ^{226}Ra in blood cells of dogs and man was determined after intravenous injection by a dilution or washing method and was found to be significant with respect to the plasma concentration. The transfer of ^{226}Ra between cells and plasma was found to be consistent with a diffusion process. (C.H.)

29867 EFFECTS OF ENVIRONMENTAL TEMPERATURE ON RETENTION OF CHRONICALLY ADMINISTERED CESIUM-137. J. E. Furchner, C. R. Richmond, and G. A. Drake (Los Alamos Scientific Lab., N. Mex.). Health Phys., 11: 623-8(July 1965). (LA-DC-6555)

Mice were exposed to environmental temperatures of 5, 22, and 34°C and simultaneously to drinking water contaminated with ^{137}Cs. A second group was similarly exposed to the same temperatures for a preliminary 2-week period, and then a constant amount of ^{137}Cs was hand fed daily to this group. The whole-body activity of the mice exposed to 34°C was about three times that of the mice exposed to 5°C. The fraction of the whole-body burden per g in the various tissues was not notably affected by temperature except in those tissues where fat was lost or where fat accumulated, and in the kidney and spleen where the temperature affected the weight of these organs. (auth)

29868 THE SOURCE OF INGESTED RADIOACTIVITY IN DESERT RODENTS. Norman R. French, Page Hayden, and Theodore Tagami (Univ. of California, Los Angeles). Health Phys., 11: 637-45(July 1965).

Using ^{131}I as a tracer, comparisons were made of the radioactivity ingested by kangaroo rats when eating contaminated food and when living on contaminated sand. Different methods of exposure served to differentiate the sand consumed with the food, the sand consumed accidentally while digging or searching for food, and the sand consumed by licking the fur. Results indicated that all routes of entry are important. On the basis of further tests, the data were extrapolated from the laboratory tests to field conditions. Deposition of airborne ^{131}I was proportional to the surface areas of materials under consideration; 1 g of sand therefore contained nine times the radioactivity of 1 g of pearl barley seeds. When hulls were removed from the contaminated grain by the rodents, only 16 percent of the radioactivity on the food was consumed. It is estimated that under field conditions kangaroo rats obtain 70 to 80 percent of their internal emitters directly or indirectly from the sand. (auth)

29869 GRAIN COUNT CORRECTIONS IN AUTORADIOGRAPHY. [PART II]. J. Stillstroem (Uppsala Univ.). Intern. J. Appl. Radiation Isotopes, 16: 357-63(June 1965).

The errors in autoradiographic work due to background influence were calculated and are represented graphically. Experiments on the variability of background are recorded. The appearance of inconsistent data when using formulae for the true proportion of labelled cells and their mean grain count is explained in terms of incompatible distributions. The transformation of the grain count distribution by varying cell size or exposure time is shown. (auth)

29870 PLATELETS AND THE SCHWARTZMAN PHENOMENON. Jack Levin and Leighton E. Cluff (Johns Hopkins Univ. School of Medicine, Baltimore). J. Exptl. Med., 121: 235-46(Feb. 1, 1965).

The effect of immunologically induced thrombocytopenia upon the local and generalized Schwartzman phenomena was evaluated. Administration of antiplatelet serum to rabbits prepared with Thorotrast-produced renal lesions were characteristic of the reaction. Immunologic thrombocytopenia did not inhibit the cutaneous hemorrhagic lesion of the local Schwartzman phenomenon produced by sequential injections of endotoxin intracutaneously and intravenously. Production of the generalized Schwartzman phenomenon with platelet antiserum suggests that the rapid destruction or removal of platelets in appropriately prepared animals is capable of producing this reaction. It is not known whether or not the platelets are lysed or removed from the circulation by the antiserum. (BBB)

29871 THE DISTRIBUTION AND BIOLOGICAL ACTION OF RADIOACTIVE ISOTOPES. Yu. I. Moskalev (Rostov Medical Inst. and Experimental Lab., North Coucasus, USSR). Med. Radiol., 10: No. 4, 53-9(Apr. 1965). (In Russian)

Studies of distribution and biological action of radioisotopes showed that isotopes differ in distribution. For example, some are deposited primarily in bones, whereas others are concentrated in two tissues such as liver and bones, and yet others are distributed uniformly through the body. Factors affecting biological action of isotopes are identified as: distribution, route of entry, resorption, and excretion. Blastomogenous action of radioisotopes is analyzed. (H.G.D.)

29872 METABOLISM OF ^{137}Cs IN RATS. CONSIDERATIONS ON THE BIOLOGICAL PERIOD. C. M. Avio, E. Polese, and M. Rossi-Torelli (CAMEN, Pisa, Italy). Minerva Nucl., 9: 26-32(Jan.-Feb. 1965). (In Italian)

A quantity of radioactivity retained over a period of time in some organs of rats after administration of a single dose of ^{137}Cs by endoperitoneal and oral methods was studied. The variation in retained radiation was also observed following administration of increasing doses of ^{137}Cs. From the results obtained it was concluded that there are no substantial differences in behavior of the radioisotope as a function of the method of administration. The quantity of ^{137}Cs retained in the organs was in linear proportion to the quantities administered, up to the dose of 0.58 $\mu C/g$ (body weight). The retention of the radioisotope following either oral or endoperitoneal administration reached its maximum value within the first 3 hr for the liver and heart and within 48 hr for the muscles, and thereafter diminished with a varying rhythm. The function, which best interprets the variation in retention of radioactivity in the organs, is represented by a sum of exponentials. (auth)

29873 NEUTROPHILIC LEUKOCYTE RESERVE OF THE BONE MARROW. 1. IN VIVO DETECTION AND QUANTITATION WITH DFP. C. Sacchetti, P. Boccaccio, A. Ponassi, and L. Morra (Universita, Genoa). Minerva Nucl., 9: 55-62(Jan.-Feb. 1965).

By administering DFP ^{32}P-diisopropylfluorophosphate intravenously it was possible to label the neutrophilic granulocytes in the blood and bone marrow. In order to check the correspondence between the plateau of the curve and the bone marrow reserve of neutrophilic leukocytes, 10 patients with tumors were examined before and after antiblastic treatment. Seventy other normal subjects were examined as controls. In patients with induced leukopenia, the duration of the plateau was decreased by more than one half, and it was deduced that the main change was a depletion of the reserve. In steady-state conditions, the neutrophilic leukocyte reserve and the maturative compartment of the bone marrow consisted of about 1196×10^9 cells. The problem of whether the two sections can be assessed separately is discussed. The role and practical importance of the bone marrow reserve are also considered. (auth)

29874 CAESIUM-137 IN POPULATION OF LODZ (POLAND) IN 1963 AND 1964. Wieslawa Karniewicz, Julian Liniecki, and Andrzej Kosterkiewicz (Inst. of Occupational Medicine, Lodz, Poland). Nukleonika, 10: 35-49(1965).

The whole-body counter at the Institute of Occupational Medicine in Lodz is described in detail. The in vivo calibration for Cs-137 and for potassium was performed using Cs-132 and K-42 as well as potassium chloride. Details of the calibration procedure are given. Cs-137 body level of adult, professionally nonexposed subjects of both sexes, inhabitants of Lodz was measured four times. In the spring and fall of 1963 and 1964 the Cs-137 : potassium ratio was 133, 181, 178, and 200 pC/K, respectively. (auth)

29875 IODINE-125 LABELED PROTEINS IN EXPERIMENTAL NEUROPATHOLOGY. Robert W. P. Cutler. Proc. Inst. Med. Chicago, 25: 128-9(Sept. 1964).

Entry of iodinated human serum albumin (^{125}I-HSA) into brain was studied in experimental cerebral edema in cats. Methods involved the production of edema with a balloon placed in the extradural space, radioassay of cortex and white matter, quantitative separation of free and protein-bound I radioactivity in plasma and brain extracts, and preparation of autoradiographs of hematoxylin and eosin stained tissue sections. Following multiple aqueous extractions of brain homogenates, a considerable portion of radioactivity remained in the residue. This finding, together with the observation of occasional peri-nuclear clusters of silver grains in the autoradiographs, suggests an intracellular locus for a portion of the extravasated protein. It was also found that the injection of heat coagulated ^{125}I HSA into guinea pigs results in the rapid isotopic labeling of circulating leukocytes. Changes in vascular permeability to leukocytes and protein occurring in EAE in the guinea pig were studied. (BBB)

29876 STUDIES ON THE ENHANCEMENT OF VIRUS TITRE OF JAPANESE B ENCEPHALITIS VIRUS PROPAGATED IN CHICK EMBRYO CELLS BY D_2O AND ITS POSSIBLE MECHANISM. Chiang-shen Mao and Chen-hsiang Huang (Chinese Academy of Medical Sciences, Peking). Sci. Sinica (Peking), 14: 885-90(June 1965).

Japanese B encephalitis virus when grown in D_2O-treated cells was found to have a higher titre than that grown in the control. The difference was found to be greater in the heat-labile Nakayama strain than in the more heat-stable Peking strain. An increase in the yields of virus was found to be related to the greater heat stability of the virus and lower production of interferon when grown in D_2O-treated cells. Thus, two factors were found in the mechanism of D_2O action, namely, the increase in heat stability of virus and the decrease in interferon production. (auth)

29877 POTASSIUM-40 CONTENT AS A BASIS FOR THE CALCULATION OF BODY CELL MASS IN MAN. Walther Burmeister (Children's Hospital, Hamburg-Saar, Ger.). Science, 148: 1336-7(June 4, 1965).

On the assumption that the potassium content of the body cell mass is constant it should be possible to estimate body cell mass by measuring potassium-40 activity with a whole-body scintillation counter. Relations of body cell mass to weight, lean body mass, and total body water are demonstrated. (auth)

29878 HIGH CESIUM UPTAKE IN WHEAT SEEDLINGS CULTURED WITH AMMONIUM. Peter L. Minotti, Doris Craig, and W. A. Jackson (North Carolina State Univ., Raleigh). Soil Sci. Soc. Am. Proc., 29: 220-1(Mar.-Apr. 1965).

Wheat seedlings grown exclusively on NH_4-N, relative to those grown exclusively on NO_3-N or without N, consistently demonstrated a markedly high capacity for subsequent Cs absorption from solutions labeled with ^{137}Cs. In addition, previous nitrogen nutrition greatly influenced the relative distribution of absorbed Cs, with percentage transport of Cs to tops being greatest in seedlings cultured with NO_3. The results could not be explained on the basis of either K content or respiratory substrate levels prior to the uptake periods. (auth)

29879 INTERPRETATION OF BIOASSAY DATA. G. W. Dolphin and S. Jackson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.329-54 of STI/PUB/84(Vol.I). (AHSB(RP)R-41)

Three categories are used in classifying the different modes of metabolism of various radionuclides. The first group includes those radionuclides that are rather uniformly distributed throughout the body. The second group includes those that are concentrated particularly in one or more organs of the body. The third group, really a specially important sub-group of the second, comprises the bone seekers. The pattern of urinary excretion and particularly its relationship to the radiation dose delivered to the critical tissues, is distinctly different for these different groups. It is emphasized that, following the recognition of an accidental intake, it is desirable to analyze a carefully planned series of urine samples, to provide a measure of the urinary excretion rate for a suitable period. The uncertainty associated with each individual result because of fluctuation in excretion rate can thus be

minimized. A somewhat different approach is suggested in the case of urine sampling for routine surveillance of a group of personnel. The data available about metabolism of the radionuclide are used to evaluate an investigation level, namely, the urinary excretion rate corresponding to a chosen level of body content. It is important that measurements for routine surveillance should be made with maximum accuracy and carefully recorded. These measurements may be used much later in making an assessment of the chronically-acquired body content. A summary is presented of the human data available on metabolism and urinary excretion of tritium, cesium, uranium, strontium, radium, and plutonium. (H.G.D.)

29880 A CRITICAL SURVEY OF THE ANALYSIS OF MICROSCOPIC DISTRIBUTION OF SOME BONE-SEEKING RADIONUCLIDES AND ASSESSMENT OF ABSORBED DOSE. W. S. S. Jee. p.369-93 of STI/PUB/84(Vol.I).

Detailed microscopic dose distribution studies describe the non-uniform distribution of the radiation in contrast to the assumed uniform distribution derived from whole-body retention data. Without some knowledge of the microscopic dose distribution in both space and time, it is all too easy to reach incorrect deductions and overlook important conclusions in our attempts to gather comparative toxicity data. Due to the complexity of the problem, the published literature of the measurement of microscopic radiation dose distribution is very limited. The present techniques involve autoradiography and are very laborious. They include track counting and microdensitometry. A complete distribution of dose in a given bone in space and time is an immense task. The microscopic distribution of bone seekers (radium-226, strontium-90, plutonium-239, and radiothorium-228) in the skeleton serves as an excellent illustration of the complexity of the problem. The initial radiation dose pattern and the altered patterns with time are described for radium and plutonium with particular emphasis on the non-uniformity of the dose distribution in bones and different sites within a bone. For example, the maximum vertebral trabecular surface deposits of plutonium are 1.5 times hotter than the maximum concentrations on femoral metaphyseal trabeculae. The ratio of dose-rates of surface-deposited plutonium in various sites within the distal femur are: metaphyseal trabecular, 3; endosteal, 2.6; epiphyseal trabecular, 1.5; haversian, 1.2; and periosteal, 1. The maximum localized surface deposit for vertebral trabeculae is 35 to 66 times greater than the calculated average whole-body retention dose-rate. The alteration of the initial non-uniform localization of radium and plutonium with time is discussed in relation to the character of the cellular remodeling of bone and the loss of radionuclide by long-term exchange. Finally, an example using local radiation dose measurements of plutonium and radium with consideration of volume of cells irradiated correlated with the whole-body retention and tumor incidence is used to derive a relative toxicity of plutonium to radium and demonstrate the value of some knowledge of microscopic radiation dose distribution. (auth)

29881 LONG TERM FEEDING STUDIES WITH ^{90}Sr CONTAMINATED DIET. M. Fingerhut. Thesis, Mainz, Universitat, 1964. 184p. (In German). $2.00 (Gmelin, AED-DISS. 64-315).

Retention of low doses of ^{90}Sr in Sprague Dawley rats was studied for 5 generations. Strontium-90 was given orally in 2 concentrations (140 and 350 pC ^{90}Sr/g Ca). Strontium-90 uptake in the skeleton followed an exponential law. Discrimination factors are given. Radiation doses were calculated from skeleton contamination. Possible extensions of the results to human beings are discussed. (Gmelin inst.)

29882 TRACER STUDIES IN RATS OF THE DIAPLACENTAR As (^{74}As) STORAGE IN FETUSES AND OF THE As TRANSFER WITH MILK. G. Schuetz. Thesis, Freiburg i. B., Universitat, 1964. 78p. (In German). $2.00 (Gmelin, AED-DISS. 64-318).

Radiation dose to fetuses during ^{74}As tracer tests of the mother was studied in 172 gravid rats given 5 μC Na-arsenate. Results indicate that about 2% of the injected activity is transferred to the fetus. The concentration ratio between mother and fetus is 7:1. Transfer of As with milk is very low. Biological half life of As in non-gravid rats is 30 to 40 days. (Gmelin Inst.)

Radiation Effects

Refer also to abstracts 30602 and 30612.

29883 (ACRH-103(p.1-27)) STUDIES IN IMMUNOLOGY. (Argonne Cancer Research Hospital, Chicago, Ill.).

Brief summaries are presented of research studies in the field of immunology. These include studies of host-tumor balance, tumor immunity and the production of tumor-specific antibodies, the effect of whole-body x irradiation on immune reactions in laboratory animals, immune reactions of mice to transplanted tumors and skin grafts, immune reactions of rats to various antigens, the effect of neonatal thymectomy on immune response of rats, the mechanism of tolerance produced in rats to sheep erythrocytes; tracer studies of antigen metabolism in rats, and factors affecting the hemolysis of human erythrocytes in vitro. (C.H.)

29884 (ACRH-103(p.37-47)) EXPERIMENTAL AND CLINICAL STUDIES OF CELL DIFFERENTIATION. (Argonne Cancer Research Hospital, Chicago, Ill.).

Brief summaries are presented of studies of cell differentiation. These include physiological studies of primitive hemopoietic cells, studies of the relation between duration and intensity of hypoxia and erythropoietin response, erythroid hypoplasia in mice following irradiation, the erythropoietic effect of testosterone in plethoric mice, studies of an erythropoietic defect in congenitally anemic mice, autoradiographic studies of human chromosomes, and the results of chromosome analysis of patients with primary refractory anemia. (C.H.)

29885 (AD-611359) INFLUENCE OF IONIZING RADIATION ON THE PHYSIOLOGY OF SPORES OF CLOSTRIDIUM BOTULINUM. Report No. 4 (Final), December 29, 1959–January 28, 1963. S. J. Deal and Gwendolyn Stewart (West Virginia Univ., Morgantown. Medical Center). Contracts DA19-129-qm-1521 and DA19-129-qm-1955. 217p. (DSSC-S-597). $6.00(CFSTI).

A method for producing, harvesting, and cleaning large numbers of spores of Cl. botulinum 62A is presented. The method enables the rapid and easy microscopic determination of physiological age. Germination studies were conducted by the use of both chemical and physical agents. Chemical agents included metabolites and non-metabolites. Physical agents were high level gamma irradiation and sonication with superbrite glass bead. The criterion of germination was the loss of dye refractility as determined by the uptake of dilute methylene blue. From a study of these specimens it appeared that a structure arose from the cytoplasmic membrane, migrated to the longitudinal axis of the cell, and established a synthetic site for spore components. The core was synthesized first, then surrounded sequentially by the inner transparent zone, the outer dense zone, and the exosporium. The participation of the cytoplasmic membrane in establishing an active synthetic site for sporulation became evident; however, elucidation of its role in subsequent stages of the process will require investigation by techniques which give greater specificity in the electron image. (auth)

29886 (ANL-6971(p.29-46)) BIOPHYSICS. (Argonne National Lab., Ill.).

The design and performance of an electronically-controlled continuous culture device for growing microbial populations under steady state conditions are described. Results are reported from studies on the effects of nitric oxide and water on the x-ray sensitivity of dry seeds and bacterial spores; the effects of 1500 R x radiation on hamster cells in tissue culture; the effects of age in the

generation cycle on the radiosensitivity of hamster cells in tissue cultures; repair processes in irradiated cells in hamster tissue cultures; the effects of light on chemically induced mutations of Escherichia coli; the effects of water content on the x-ray sensitivity of Staphylococcus aureus; and the genetic effects of x radiation in hamster cells in culture. (C.H.)

29887 (ANL-6971(p.47-58)) CARCINOGENESIS. (Argonne National Lab., Ill.).

Progress is reported in studies of carcinogenic processes on the cellular level with emphasis on the relation of x radiation to cancer induction in mice, the carcinogenic effects of $^{90}Sr-^{90}Y$ beads embedded under the skin, or ^{239}Pu locally injected; neutron capture therapy of tumors, with emphasis on the development of compounds that will localize in cerebral and somatic tumors and the improvement of neutron sources; the synthesis of U compounds suitable for the neutron capture therapy of tumors; studies of the dynamics of growth in normal and tumor tissues of mice, rabbits, and rats using a mathematical approach, and the development of an in vivo carcinogen target tissue system for use in studies on the relation of DNA content of carcinogenic response of tissues. (C.H.)

29888 (ANL-6971(p.59-82)) CELLULAR FINE STRUCTURE. (Argonne National Lab., Ill.).

Progress is reported in studies of cellular fine structure in Chlorella vulgaris during Chlorophyll production; in centrifuged nuclei of Amoeba proteus and Pelomyxa illinoisensis; the molecular stability and composition of organelles of Paramecium; ultrastructural studies on the slime mold, Didymium nigripes and other protozoa; the effect of ph, ions, and fixing agents on intracellular components seen with the electron microscope; the effects of x radiation on developing connective tissue; and studies of the fine structure of the osteocyte capsule in bone samples from dogs, guinea pigs, and rats of various age groups. (C.H.)

29889 (ANL-6971(p.90-116)) EXTERNAL RADIATION TOXICITY. (Argonne National Lab., Ill.).

Progress is reported in studies of acute and chronic lethal radiation effects. Data are included from studies of vascular permeability changes in chicks in response to various doses of ^{60}Co γ radiation; studies of the comparative physiology and anatomy of aging and radiosensitivity, using rodent species covering an appreciable range of adult body weights and adult brain weights, with emphasis on Mus, the wild ancestor of the laboratory mouse, and Peromyscus, the deer mouse; the effect of lifetime periodic γ exposure on the survival and pathology of guinea pigs; studies on the biology of a small South American fish, Cynolebias adloffi, of interest as a test object in radiobiological studies; the effects of γ and x radiation on the growth and survival of chickens; the comparative effects of fission neutrons and ^{60}Co γ rays on bone marrow cells of the mouse as measured by spleen-colony growth; the intestinal bacteria of laboratory mice and the effects of a diet containing sodium deoxycholate on normal intestinal flora; attempts to localize a brain inhibitor in chick development; the effects of single and continuous exposures, at high and low doses, to x radiation, γ radiation, and fission neutrons on cell renewal and metabolic activity of rapidly dividing, short-lived duodenal crypt cells and long-lived, metabolically active liver cells of mice and rats; and the development of a combination of chemical and computer methods for the dosimetry of neutrons and mixed neutron-γ fields to cover the range of neutron energies from thermal to at least 15 Mev. The production of monoenergetic neutron groups at 1.22 and 0.426 Mev for radiobiological use via the delayed neutron emitter ^{17}N produced in a reactor using $^{6}Li^{18}O \cdot H_2{}^{18}O$ irradiated to saturation was proved feasible; and the development of monoenergetic neutron sources for radiobiology using accelerators and the $^{7}Li(p,n)$ reaction or rotating Cu targets is discussed. The development of a calorimeter operating at 4.2°K for use in measurements of absolute neutron dose is described. Methods used for fast neutron dosimetry are reviewed and difficulties associated with the calculation of linear energy transfer are discussed. (C.H.)

29890 (ANL-6971(p.117-19)) NEUTRON AND GAMMA-RAY TOXICITY STUDIES (JANUS PROGRAM). (Argonne National Lab., Ill.).

The program for investigating the toxic actions of neutrons and γ radiation on mammals using the Janus reactor and the γ irradiation rooms is outlined. Data are included from preliminary studies of neutron dose during test operation of the Janus reactor. (C.H.)

29891 (ANL-6971(p.120-32)) GENETICS. (Argonne National Lab., Ill.).

Progress is reported in a variety of genetic studies. Data are presented from studies on the effects of purine compounds on mutation in Escherichia coli; the induction of chromosome aberrations in pig kidney cells in culture by far-red light; an analysis of the genetic basis of radiosensitivity in mice; mutations in continuous cultures of bacteriophage; the development of a new technique for classifying somatic chromosomes automatically by digital computer techniques; and the estimation of the spontaneous mutation rate for sex-linked lethal genes in the mouse in a constant environment. (C.H.)

29892 (ANL-6971(p.143-58)) PHYSIOLOGY. (Argonne National Lab., Ill.).

Observations on ground squirrels, Citellus tridecemlineatus, exposed to fractionated lethal doses of radiation given during hibernation indicate that almost complete recovery occurred between the split doses of x radiation. Data are included from studies of delayed hypersensitivity to Trichinella spiralis antigens in guinea pigs; double tracer studies, using ^{3}H-thymidine and ^{14}C-thymidine and autoradiograph, of DNA synthesis in myeloid-erythroid precursors in human and dog bone marrow; antigen-antibody reactions in mast cells, the nature of the secretory activity of mast cells, and the ultrastructure of mast cells from rats; and studies of antibody formation in x-irradiated rabbits. An in vivo perfusion system is described that was developed for use in the maintenance of bone marrow cells of rats and rabbits in functionally active preparations. (C.H.)

29893 (ANL-6971(p.166-205)) PLANT RADIOBIOLOGY. (Argonne National Lab., Ill.).

Progress is reported in studies of changes in plants at morphological, physiological, and biochemical levels of organization induced by continuous reorientation of field direction. Design features are described of an apparatus to move plants and tissues about single and 2- and 3-coordinate orbits simultaneously. Preliminary observations made on plants of Arabidopsis, Spiradela, and Avena grown from seed in an apparatus that provided compensation for earth gravitational and magnetic fields, at the same time imposing a centrifugal force on the test organism of about 5×10^{-4} g in a plane normal to vertical. The purpose of the experiment is to obtain data for educated guesses about the behavior and development of terrestrial plants in extraterrestrial environments. The relation between geoelectric effect and geotropic curvature was investigated in seedlings of Zea mays under aerobic and anaerobic conditions. Results are reported from tracer studies of hormonal relations in the phytotropic response of plants and auxin transport in flowering and vegetative parts of plants; and the effects of x radiation on growth and metabolism in seeds. (C.H.)

29894 (ANL-6971(p.215-23)) THEORETICAL BIOLOGY. (Argonne National Lab., Ill.).

The development of computer techniques for the analysis of data from biological studies is discussed. The development of mathematical models for use in studies of the dynamics of cellular populations, the development of the stoichastic theory of mortality, the development of a mathematical model for studies of the kinetics of radiation injury accumulation and reversal, the computer simulation of granulocyte kinetics, a mathematical model for use in estimations of generation time and dividing fraction of a

cell population labeled with tritiated thymidine, and mathematical procedures for the determination of the effects of x and γ radiation on growth and accumulated radiation injury in bird populations are discussed. (C.H.)

29895 (BNL-908) MEDICAL SURVEY OF THE PEOPLE OF RONGELAP AND UTIRIK ISLANDS NINE AND TEN YEARS AFTER EXPOSURE TO FALLOUT RADIATION (MARCH 1963 AND MARCH 1964). Robert A. Conard, Leo M. Meyer, Wataru W. Sutow, et al. (Brookhaven National Lab., Upton, N. Y.). May 1965. Contract AT(30-2)-Gen-16. 174p. Dep.; $5.00(cy), 4(mn) CFSTI.

The results of a medical survey of the people of Rongelap in the Marshall Islands, carried out in March 1963 and March 1964, 9 and 10 years after the accident, are presented. These people had been accidentally exposed to fallout radiation following a detonation of a high yield thermonuclear device during experiments at Bikini in the Pacific Proving Grounds in March 1954. Of the inhabitants of the island of Rongelap, 105 nautical miles away from the detonation, 64 received the largest fallout exposure: an estimated dose of 175 rads of whole-body gamma radiation, contamination of the skin sufficient to result in beta burns, and slight internal absorption of radioactive materials through inhalation and ingestion. The exposed people were evacuated from the islands about two days after the accident and taken to Kwajalein Naval Base about 150 miles to the south, where they received extensive examinations for the following three months. Because Rongelap Atoll was considered to be too highly contaminated, a temporary village was constructed for the Rongelap people on Majuro Atoll several hundred miles to the south, where they lived for the following $3\frac{1}{2}$ years and were examined at yearly intervals by a special medical team. In July 1957, after careful evaluation of the radioactive contamination situation, Rongelap Island was considered safe for habitation. A new village was constructed, and the Rongelap people were moved there. Annual medical surveys have been carried out. A group of more than 100 Rongelap people, who were relatives of the exposed people but had been away from the island at the time of the accident, moved back with the Rongelap people to their home island and have served as an ideal comparison population for the studies. Data are tabulated from physical and medical examinations made in 1963 and 1964. Medical evaluation of the health status of the exposed Rongelap people revealed about the same incidence of illness and disease as in the unexposed population with the exception of slight changes in bone marrow in a few individuals, the development of thyroid nodules in 3 teen-age girls, and slight growth retardation in exposed boys. No leukemia or cases of cancer that might be attributed to radiation exposure were found. (39 references.) (C.H.)

29896 (EUR-2201.f) RADIOLOGIE CELLULAIRE ET BIOCHIMIQUE. Rapport Final, 1964. (Cellular and Biochemical Radiobiology. Final Report, 1964). (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1965. 25p. Dep.(mn).

Using microelectrophoresis in agar, immuno-electrophoresis, and incorporation of amino-acids, the protein changes in the serum and various tissues of mice irradiated with a lethal and sublethal dose of x rays were studied. The permeability of cellular and tissue membranes to macromolecules and the influence thereon of radiations were studied in both vegetable and animal organs (genital organs and hyperplasia, normal and cancerous tissues, embryo tissues). Data are included from studies of the intracellular distribution of the cytoplasmic hydrolases; the relation between the activity of acid DNAse and growth; the inhibition of DNA-polymerase by rat-liver microsomes; the thymidine phosphokinases; and the isotopic effect of tritium. (Euratom ab.)

29897 (EUR-2218.e) A CHROMOSOME REGION IN PISUM WITH AN EXCEPTIONALLY HIGH SUSCEPTIBILITY TO X RAYS. W. Gottschalk (Bonn Univ. (West Germany)). 1965. 6p. (CONF-551-4). Dep.(mn).

From Technical Meeting on the Use of Induced Mutations in Plant Breeding Programs, Rome, May-June 1964.

After seed-irradiation of Pisum sativum, five narrow-leafed mutants were obtained. On an average, the yields of the identical mutants Nos. 81 D,1 12 G, 176 A and 1201 D (dim^1dim^1/Ster Ster) were, after consideration of four subsequent years, 20% over the corresponding values of our standard form. The mutant 180 A (dim dim/ster ster), which also possesses narrow leaves, is sterile in the female sex. By hybridization experiments it could be shown that the narrow-leafness of the whole group is due to the action of a series of multiple alleles and the genes Dim and Ster are absolutely linked. The occurrence of at least four mutation processes within the same small chromosome region is probably due to a strikingly high susceptibility of this region to x rays. (auth)

29898 (HW-SA-3627) TOXICITY OF DEUTERIUM OXIDE TO THE FRESH WATER FISH AEQUIDANS PORTALEGRENSIS: SURVIVAL OF EMBRYOS AND YOUNG FISH. M. P. Fujihara and R. T. O'Brien (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). [July 20, 1964]. Contract AT(45-1)-1350. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Sensitivity of cichlid eggs was dependent on the development stage with early stages being most sensitive. No eggs survived in 40 percent D_2O. Young fish of various ages survived in 30 percent D_2O whereas 40 percent was lethal. (auth)

29899 (JINR-P-2069) METODY EKSPERIMENTAL'NOGO OPREDELENIYA LPE RASPREDELENII I FAKTORA KACHESTVA PRONIKAYUSHCHEGO IZLUCHENIYA. (Experimental Determination of the Distribution of Local Energy Losses (LEL) and of the Quality Factor of Ionizing Radiation). V. N. Lebedev (Joint Inst. for Nuclear Research, Dubna (USSR)). 1965. 14p. Dep.(mn).

Problems related to the practical determination of radiation danger in the field of unknown mixed radiation demanding a fast mean determination of the radiation quality and ionization along the total local absorption energy (LAE) spectrum were resolved by recombination method. The problems of biological effects with variable local absorption energy demanding much more precise answers were resolved by the Rossi-Rozensweig method. (R.V.J.)

29900 (NYO-901-33) LOW-DOSE I-131 INHIBITION OF H^3TDN INCORPORATION BY MOUSE THYROID CELLS. David L. Joftes (New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.). [June 16, 1965]. Contract AT(30-1)-901. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Mice injected with ^{131}I were injected on the 3rd, 90th or 175th day with tritiated thymidine and the thyroid and ileum of each animal were examined histologically and autoradiograms were prepared for examination for DNA synthesis. The results indicated that very low doses of β radiation inhibit the incorporation of 3H-thymidine into DNA in mouse thyroid soon after the administration of ^{131}I, but that this inhibition is lost at some time before 90 days. (C.H.)

29901 (RLO-1754-1) THE EFFECT OF RADIATION ON MEMBRANE METABOLISM AND ACTIVE TRANSPORT. Comprehensive Progress Report. John T. Van Bruggen (Oregon Univ., Portland. Medical School). [1965]. Contract AT(45-1)-1754. 28p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Data are reported from studies of mechanisms involved in membrane metabolism and active transport in frog skin in which ^{14}C labeled metabolites were used as tracers. The experimental technique is described. Results are included on the effects of cholinesterase, ovabain, hypermolarity, and dimethyl sulfoxide on membrane permeability. A dose of 1500 R x radiation administered to mounted frog skins did not cause an immediate change in the electrical characteristics of the skin, active Na transport, or ^{14}C-acetate utilization. The oxygen consumption, ^{14}C-glucose metabolism, and water permeability of the skins were increased after irradiation. (C.H.)

29902 (TID-18616(Rev.)) LABORATORY EXPERIMENTS IN RADIATION BIOLOGY. Edward I. Shaw (Kansas Univ., Lawrence). Apr. 1965. Contract AT(11-1)-1093. 85p. Dep.; $0.50(cy), 2(mn) GPO.

This manual contains a set of experiments for use in courses in radiobiology. The fundamental aspects of radiation detectors, sample preparation, counting statistics, radiation source calibration, radiation safety, and the general requirements for tracer experiments are covered. Typical experiments include the use of autoradiography in studies of the translocation of radioisotopes in plants, the use of chromatography in the identification of labeled compounds; the metabolism of ^{32}P and ^{131}I in rats, the effects of radiation on Fe metabolism in rats, and radioinduced chromosome aberrations in plants. A list is included of references and sources of information on radiation biology. (C.H.)

29903 (TID-21877) THE EFFECTS OF X IRRADIATION ON THE EMBRYOS OF INVERTEBRATE EMBRYOS. Wesley Larsen (College of Southern Utah, Cedar City). [1965]. Contract AT(11-1)-1030. 13p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The effects of x radiation at dosages ranging from 50 to 12,000 R on the development of embryos of the ovoviviparous cockroach, Blaberus craniifer, exposed at various ages ranging from 1 to 52 days were studied. Approximately 3,750 embryos were examined and microscopic sections made of the those specimens exhibiting gross deformities, cessation of growth, or abnormalities in size. Embryos were found to become resistant to x radiation suddenly just prior to the stage of dorsal closure. Embryos that had passed this stage when irradiated continued to develop normally until dosages reached levels of 2000 to 5000 R. Gross abnormalities ranged from individual slightly retarded in growth to embryos represented by an amorphous mass. Typical abnormalities found are described. Tissue cultures of heart fragments, gut sections, and Malpighian tubules of Blaberus were prepared and survived for periods varying from 5 mo to 2.5 yr. The effects of γ radiation at dosages up to 93,000 rads were studied, the use of function in heart fragments in testing various radioprotective chemicals, and the effects of oxygen and hypothermia on radiosensitivity were investigated. Results are summarized. Data are also included from studies of reactions of heart fragments from embryos of Blaberus to several vital strains and the effects of various growth hormones on the growth pattern of embryonic insect organ cultures. (C.H.)

29904 (UCRL-16030) DARK RECOVERY OF YEAST FOLLOWING IONIZING RADIATIONS (thesis). John T. Lyman (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 30, 1965. Contract W-7405-eng-48. 77p. Dep.(mn); $2.00(cy), 2(mn) CFSTI.

The relationship between the recovery of irradiated diploid yeast and the LET of the radiation was studied and an attempt was made to differentiate between certain proposed recovery mechanisms. The results of irradiation with x rays and heavy-ion beams demonstrated that the recovery mechanism operates independently of the LET of the radiation, and also operates independently of the glycerol protection mechanism. Experiments designed to elucidate the nature of the recovery mechanism showed that besides the observed increase in viability, there is also a decrease in the induced allelic recombination frequency, a decrease in the time to form a visible colony, and a decrease in the dependence upon nutrient co-factors for the expression of the induced allelic recombination. Results were compared with the results expected on the basis of the different proposed recovery mechanisms. These comparisons suggest that the most likely recovery mechanism may be based upon the reunion of broken segments of DNA or upon enzymatic repair of damaged segments. (85 references.) (C.H.)

29905 (JPRS-29112(p.19-25)) THE STUDY OF ELECTRIC RESISTANCE AND AUTOLYSIS OF THE SPLEEN TISSUE OF IRRADIATED ANIMALS. E. V. Burlakova and M. L. Kakushkina. Translated from Vestn. Mosk. Univ., Ser. VI: Biol., Pochvoved., No. 6, 15-18(Nov.-Dec. 1964).

The measurements of the value of electric low-frequency resistance and the rate of autolysis of the surviving spleen tissue of normal rats and rats irradiated with γ rays revealed an increase of low-frequency resistance in the spleen tissue upon its prolonged survival, especially in the spleen of control animals. A correlation, expressed by a ratio equal to 0.89, exists between the increase in the value of low-frequency resistance and the intensification of the processes of autolysis in the spleen of irradiated rats. (auth)

29906 (JPRS-29904) REPARATIVE REGENERATION OF TISSUE UNDER THE EFFECT OF IONIZING RADIATION. V. P. Mikhaylov. Translated from Arkh. Anat., Gistol. i Embriol., 48: No. 2, 3-16(Feb. 1965). 22p. (TT-65-30894). $1.00(CFSTI).

Results are summarized from a series of studies on the course of regeneration of various tissues of mice and rabbits following exposure to single whole-body x radiation doses ranging from 500 to 1000 R and single local x radiation doses ranging from 1000 to 6000 R. Factors involved in tissue radiosensitivity are reviewed. It is concluded that the main causes inhibiting the regeneration of tissue in acute radiation disease lie not so much in weakened proliferative capacity of the tissue as in the radioinduced disruption of functions of the whole organism. (96 references). (C.H.)

29907 (JPRS-30161) LEUKEMIA AND IONIZING RADIATION. M. V. Svyatukhin. Translated from Arkh. Patol., 27: No. 2, 6-13(1965). 14p. (TT-65-31032). $1.00(CFSTI).

Data are reviewed from a number of studies on radioinduced leukemia in experimental animals. Data are included from studies of leukemia in man. It is concluded that the data indicate a leukemogenic action of ionizing radiation, but the mechanisms involved have not been identified. (C.H.)

29908 ASPECTS OF CELL FORMATION AND EXFOLIATION. Felix D. Bertalanffy (Univ. of Manitoba, Winnipeg). Acta. Cytol., 8: 373-6(Sept.-Oct. 1964).

The hypothesis that pressure exerted by newly formed cells is responsible for epithelial cell desquamation is examined. The chief reason for rejection of this pressure theory was the observation of cell loss from intestinal villi following irradiation, despite inhibition of new formation of cells. This argument is reexamined in the light of recent research, and cell loss from the normal and irradiated intestinal villus is compared. Complete inhibition of intestinal mitotic activity is not achieved even with fairly high doses. In continuous irradiation with 415 R/day, following an initial decline during the first 24 to 48 hr, a nearly normal steady-state cell population is restored by the 5th day. Practically complete mitotic inhibition in intestinal crypts occurs after massive doses, 1000 R and more. After 48 hr, the nuclei of the villous cells are enlarged, distorted, and pyknotic, the cell boundaries irregular and incomplete, and the epithelial sheet separated by massive edema. The epithelium begins to slough off, often in sheets, so that by 60 hr open lesions on the villous apex occurred of about one-fourth of the villi. At 72 hr, the connective tissue stroma of some villi are bare. By 96 hr, most of the villi have collapsed, and by 120 hr, the entire villi and crypts are denuded. Pronounced degenerative changes as described for irradiated cells are never observed in the normal intestinal lining. Edematous fluid producing a separation between epithelium and connective tissue stroma is also absent. Further, the manner by which cells are lost from the irradiated villus is unlike cell extrusion from the normal epithelium. Thus a parallelism can not be drawn between normal intestinal cell exfoliation and cell loss following irradiation of the intestine. Some speculations are made on the cause of degeneration of the irradiated villous epithelium. Since irradiated cells are not extruded in accordance with their life span (maybe owing to lack of newly formed cells, if the pressure theory is applied), they remain longer in the epithelium than normally; prolonged enzymatic action on the cells may be a major contributing factor in their progressive pyknosis, vacuolation, degeneration, and ultimate disappearance. That cell desquamation is not caused by

mere mechanical abrasion has been shown, and the pressure theory offers the most plausible explanation so far suggested for cell exfoliation. (BBB)

29909 RESISTANCE TO ULTRAVIOLET IRRADIATION OF THE ABILITY OF PRIMARY CELL CULTURES AND OF STABLE CELL LINES TO SUPPORT VIRUS REPLICATION. M. Rosenberg and M. Rosenbergova (Inst. of Virology, Czechoslovak Academy of Sciences, Bratislava). Acta Virol. (Prague), 8: 396-400(Sept. 1964).

The resistance to uv light of the ability of chick embryo cells (CEC) and HeLa and L cells to support multiplication of Newcastle disease virus (NDV), vesicular stomatitis virus (VSV), and pseudorabies virus was examined. In experiments with NDV, the resistance of primary CEC cultures susceptible to the virus and giving high virus yields, as well as of stable cell lines (HeLa and L) relatively insusceptible to the virus and giving low yields, was investigated. CEC uv irradiated for up to 120 sec were not only fully susceptible to virus infection, but the yield of virus from these cells was regularly higher than from nonirradiated controls. After longer irradiation, i.e. for 240 or 480 sec, the virus yield was lower than in nonirradiated cells, but this decrease did not exceed 1 logarithmic unit. Maximal virus yield was obtained after irradiation for 20 sec. HeLa and L cells exhibited a resistance similar to CEC, and when irradiated for 120 sec, they synthesized as much virus as nonirradiated cells. Maximal yield of virus was obtained from L cells irradiated for 60 sec, which was comparable with the increase in virus yield from CEC irradiated for 30 sec. Thus with L cells the maximal yield of virus was shifted to higher doses of radiation. The increase in the yield of NDV from irradiated HeLa cells was not so marked, but could be reproducibly demonstrated. The New Jersey strain of VSV gives relatively low yields in CEC, and does not multiply in L cells at all. The Indiana strain reaches high titers both in CEC and L cells, and produces a cytopathic effect. With both VSV strains, a high resistance of either cell type was observed. With the New Jersey strain, the level of virus in cultures irradiated for 240 sec was higher than in nonirradiated cultures, but with the Indiana strain the virus level in cultures irradiated for 240 sec was the same as in nonirradiated cells. Results obtained with pseudorabies virus were different from those observed with NDV or VSV. The ability of CEC and L cells to support pseudorabies virus multiplication was highly sensitive to the action of uv light. The yield of virus decreased rapidly with increasing time of irradiation. Thus the resistance of the virus-synthesizing ability of cells to uv irradiation does not depend on the cell type, but on the virus, indicating that the mechanism of replication of these viruses is different. (BBB)

29910 ATMOSPHERIC FACTORS IN PATHOGENESIS OF LUNG CANCER. Paul Kotin and Hans L. Falk (National Cancer Inst., Bethesda, Md.). Advan. Cancer Res., 7: 475-514(1963).

Environmental factors in lung cancer are surveyed, with references to 160 publications. The demonstration by Haerting and Hesse in 1879 that the pulmonary disease in radioactive ore miners in Schneeberg was lung cancer was the first instance in which the atmospheric environment was identified as the source of pulmonary carcinogenic agents. In the intervening years an increased mortality from cancers of the respiratory tract has been shown to be associated with occupational exposure to several other environmental agents. An increased incidence in lung cancer has been reported in chromate workers, and incidence of cancer of the nasal passages as well as of the lung among employees in nickel refineries was reported. These instances of occupational lung cancer, though responsible for only a small proportion of the over-all incidence, unequivocally establish a role for environmental factors in the pathogenesis of this disease. The most satisfactory explanation for the consistent observation of an increased incidence of lung cancer in urban populations is exposure to polluted air. Epidemiological, physicochemical, and biological data are presented that strongly support an etiological role for polluted atmosphere. In addition to the carcinogenic hydrocarbons identified in urban air, trace amounts of other known or suspected carcinogenic agents have also been identified. Besides agents primarily industrial in source including effluents from nickel refining and chromate manufacture, ionizing radiation is implicated. Initially, the sources of atmospheric radioactivity were limited to the mining of radioactive ores and the contamination incidental to the refining and industrial use of radioactive materials. To this must now be added the atmospheric contamination secondary to the detonation of nuclear devices. Recognition and growing acceptance of the concept that multiple factors are concerned with the initiation and promotion of lung cancer make it evident that close correlation with any single suspected environmental factor will be limited. The successful production of epidermoid carcinomas of the lung in mice was reported following the intrapulmonary instillation of ^{60}Co wire implants. Earlier, aerosols of radiocerium and an atmosphere containing soluble and insoluble beryllium salts, as inhalants, produced malignant pulmonary epithelial neoplasms in rats. The first reported production of epidermoid carcinoma of the lung in C57 Black mice following exposure to inhalants was reported for mice exposed to multiple influenza viral infection and aerosols of ozonized gasoline. The growing experimental data suggest a role for viral agents in the pathogenesis of neoplastic disease in studies utilizing both oncogenic and nononcogenic viruses in combination with chemical carcinogens. While atmospheric pollution is one potential source of agents carcinogenic to the lung, proper evaluation of its contribution to the pathogenesis of lung cancer will be possible only in terms of its relation to the action of other significant environmental sources. (BBB)

29911 UTILIZATION OF IONIZING RADIATION FOR OBTENTION OF USEFUL MUTATIONS. N. F. Batygin. Agrobiologiya, No. 4 611-13(1964). (In Russian)

Investigations concerning controlled mutations involved attempts to increase the mutability, careful choice of the parent plants, and changes induced in the plants by controlling the external factors; these methods may be applied jointly, as when hybridization is carried out under controlled conditions of cultivation. The theories of Michurin and Lysenko are surveyed. The role of ionizing radiation has been investigated many times. Instead of creating new species directly, the radioinduced mutations only provide the starting material for further studies. Depending on the dose, the radiation may exert a stimulating or inhibiting effect. The degree of stimulation depends also on the physical state such as dryness, of the irradiated material and the stage of growth. The radiation does not exert an overall action but influences only the processes that take place during the exposure. Continued increase of the dose results in inhibition of the growth rate; at the same time, the number of mutations in later generations also increases. The radiation as a tool does not exclude or replace the usual method of selection; the judicious joint use of these methods, such as hybridization, alteration, interaction of light and temperature, etc., makes it possible to optimize certain desired properties. (TTT)

29912 CHROMOSOME ANALYSIS IN THE RAT EMBRYO. M. T. Biola (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Ann. Genet., 7: 106-7(1964). (In French)

The rat chromosome pattern is described and illustrated, and its use in the study of radiation genetics and the action of various mutagenic agents is discussed. (BBB)

29913 RENAL CHANGES FOLLOWING RETROGRADE PYELOGRAPHY USING THOROTRAST. W. P. H. A. Rijnders, H. J. Ybema, P. J. Donker, and J. A. G. Ten Berg (Dykzigt Ziekenhuis, Rotterdam). Arch. Chir. Neerl., 15: 157-73(1963).

The literature pertaining to late pathological effects of Thorotrast is surveyed, one new case is described in detail, and two more unpublished cases seen recently in the Netherlands are mentioned. Thorotrast is a 2.5% colloidal solution of ThO_2 which in 1928 was used for the first time as a contrast medium in radiology. It has been used for hepatolienography, various types of angiography, fillings

of paranasal sinuses or abscesses (also in the brain), sialography, and retrograde pyelography. Its radioactivity has a very long half-life (1.39×10^{10} yr), and hardly any of it is excreted. From 1946 to 1961 59 cases of malignant tumors following administration of Thorotrast had been reported. In the case presented, a 47-yr-old woman complaining of pain in the right lumbar region was examined 27 yr after bilateral retrograde pyelography carried out with Thorotrast. At examination a firm, immobile tumor was palpated in the right abdomen. The liver was palpable and its margin was sharp. After intravenous injection of contrast medium no excretion at all was observed on the right, whereas the left pyelogram was normal. The contrast material seemed to be localized in the renal parenchyma near the calyces. The diagnosis was a stenotic process at the transition from pelvis to ureter and contraction and hydronephrosis of the right kidney. At operation the kidney was found to be firmly adherent to the peritoneum and the duodenum. Two months afterwards, metastasis of tumor to the skin and liver was definitely observed. The patient died three months after the nephrectomy. The renal changes at autopsy were as follows: (1) Thorotrast granuloma below the pelvis and around the ureter with ureteral stenosis, hydronephrosis, and renal contraction; (2) irradiation angiopathy of the subpelvic blood vessels; and (3) carcinoma of the pelvis of the right kidney. Thorotrast deposits were found in both kidneys, in the lumbar paravertebral lymph nodes, liver, and spleen. The radioactivity (predominantly γ activity) in specimens obtained from the right kidney was measured using a scintillation counter, and the quantity of ^{232}Th in the same samples were chemically determined. In some areas of the kidney Th content was as high as 3315 μg, radioactivity 1558 cpm, and sp act. 0.47 cpm/μg Th (in $^1/_{12}$ of the total kidney mass). The total amount of Th contained in this kidney was 11 mg, and it was possible to demonstrate the α radiation with historadioautograms. As stated above, 98% of the energy of Th decay consists of α radiation, the β and γ radiation may be neglected in dose consideration. The x-ray photographs showed that the Thorotrast was not homogeneously distributed in the tissue. Since, the range of the α radiation in the tissue is only 20 to 80 μ, it is impossible to assess the amount of radiation received by the whole kidney. It was possible to estimate the radiation absorbed by a particular small piece of renal tissue. Calculations led to the conclusion that 0.164 erg per week was absorbed by 1 mg of tissue, i.e., 1.64 Rad per week, in one histologic section, considering the various daughter product contributions to the total dose. This case is considered to demonstrate the carcinogenic action of Thorotrast. (BBB)

29914 CYTOCHEMICAL STUDIES OF VAGINAL SMEARS. III. CHANGES IN INTRACELLULAR ASCORBIC ACID IN VAGINAL EXFOLIATIVE ELEMENTS AFTER IRRADIATION. A. Granata and P. Stradella (Universita, Messina, Italy). Arch. Ostet. Ginecol., 68: 221-7(May-June 1963). (In Italian)

Cytochemical studies were made of vaginal cells of women who had received intracavitary Ra treatment for uterine carcinoma. Ascorbic acid was determined in exfoliated cells by a method depending upon its metachromatic staining. The vaginal smears were obtained seven to ten days after radiotherapy. Topological modifications in intracellular ascorbic acid were found after irradiation. The granulations corresponding to the vitamin were larger in volume and were distributed around the periphery of intracellular vacuoles, unlike the more random distribution in normal exfoliated vaginal cells. This migration of vitamin was interpreted as reflecting devitalization of the nucleus and involution of the cell. The nuclei of the cells tended toward pyknosis, with agglomeration of Feulgen-staining material. The accumulation of ascorbic acid around intracellular vacuoles may represent depressed cell function, as no such vacuoles surrounded by ascorbic acid were seen in healthy cells. It is concluded that changes in ascorbic acid distribution in irradiated cells provide an additional index for assessing radiation injured cells. (BBB)

29915 ON THE CANCEROGENICITY OF CHOLESTEROL AND ITS 5- OR 7-HYDROPEROXIDE. R. Koch (Universitat, Freiburg i. B.). Arzneimittel-Forsch., 13: 1116-17(1963). (In German)

Previous studies in rats have indicated that after a single whole-body irradiation with 600 R of x ray, which followed intraperitoneal injection of cholesterol or cholesterol-5-hydroperoxide, the incidence of fibroadenoma, carcinoma, and sarcoma two yr later is from 9.5 to 17.4%. The appearance of these tumors seemed to be the result of age or the irradiation rather than of the injected chemicals. The authors studied tumor incidence in male mice with a spontaneous tumor rate of 0%, and in female mice with a rate of 10.2%. As shown by the results 2 yr after injection of cholesterol, or its 5- or 7-hydroperoxide, only the 5-hydroperoxide showed any cancerogenic effect at all. This effect appeared to be based on enhancement of the spontaneous tumor rate of the animals, and could thus be termed co-cancerogenic in effect. (BBB)

29916 KINETICS OF THE INACTIVATION OF VIRUSES. C. W. Hiatt (National Inst. of Health, Bethesda, Md.). Bacteriol. Rev., 28: 160-63(June 1964).

Some of the factors which influence the rate of inactivation of viruses are discussed to show how these factors must be taken into account in interpreting kinetic data. Thermal and chemical agents, as well as uv and ionizing radiation, have been used to study inactivation of viruses. One of the classical controversies in quantitative biology concerns the significance of variations in shape of survival curves of micro-organisms subjected to the lethal action of these physical or chemical agents. Early investigators studying the effects of x rays or electron beams on survival of microorganisms presented the concept of the microorganisms as targets being bombarded from a source of radiant energy and destroyed when hit by a photon or electron. The target theory is described in simplified form. If a given microorganism has a sensitive volume $\underline{a}$ and is irradiated so that there are, on the average, $\underline{D}$ ionizations per unit volume, then the average number of ionizations within the sensitive volume will be $\underline{aD}$. The survival ratio at dose $\underline{D}$ is represented by: $(\underline{N}/\underline{N}_0 = e^{-\underline{aD}}$, for a one-hit process, which gives a straight line in a semilogarithmic plot. Multiple-hit survival curves have initial shoulders of varying breadth depending upon the number of sublethal hits which must accumulate before the organism is killed. At higher doses, the curves approximate straight lines of divergent slope. The basic assumption in the multiple-hit theory described is that a single target must be hit n times before it is destroyed. An alternate hypothesis is that each organism contains $\underline{n}$ identical targets, each of which must be hit once to be destroyed, and all $\underline{n}$ of which must be destroyed to kill the organism: $(\underline{N}/\underline{N}_0) = 1 - (1 - e^{-\underline{aD}})$. This equation can be extended to the more complex case in which $\underline{n}$ is distributed in value, or for the circumstance in which there are several lethal processes involving different sets of sensitive sites. These equations are similar and either may be used to fit experimental data, but the model for the second equation is more meaningful in view of the present concept of viruses as composed of repeating structural units. The target theory interpretation of kinetic data for processes dependent upon radiant energy offers two distinct advantages: (1) it permits estimation of the sensitive volume of the organism, which may lead to associating sensitivity with an identifiable component, and (2) it supplies an explanation for the initial shoulder that may be seen in the survival curve. (BBB)

29917 THE INFLUENCE OF IONIZING RADIATION ON CELL METABOLISM. W. de Loecker (Universitet Leuven, Louvain, Belg.). Belg. Tijdschr. Geneesk., 19: 1077-86 (Oct. 15, 1963). (In Dutch)

The action of γ rays on water produces a pair of radicals, followed by formation of HO_2. Thus pyrimidines in oxygen-containing water have their 5,6-double bond oxidized to form a hydroxy hydroperoxide. Other processes also contribute to changes in the nucleic acids. The function of the nucleic acids in normal systems is reviewed: the structure of nucleotides and of DNA, the synthesis of DNA, and the

transfer of information are generally outlined. The topic of the influence of irradiation on biological systems is divided into two sections: a review of known effects of irradiation on nucleic acids, and the effect of cell division. The first recalls the effect of irradiation on synthesis of nucleotides and the inhibition of DNA-polymerase synthesis, and refers again to the radiation effects for the purines and pyrimidines themselves. Thus the effect is a combination of a direct radiative effect and an enzymatic factor. The inhibition of cell mitosis is also considered; blockage of –SH groups is known to inhibit cell division. Radiation damage may thus be founded on these two processes, which may operate synergistically. (BBB)

29918 CHANGE IN THE PROPERTIES OF DEOXYRIBONUCLEIC ACID OF THE BONE MARROW AFTER X-RAY IRRADIATION OF ANIMALS. G. A. Kritskii, R. N. Safronova, Yu. T. Kovtun, S. Ya. Mirlina, and L. F. Malysheva (Bakh Inst of Chemistry, Moscow and Moscow State Univ.). Biochemistry (USSR) (English Transl), 29: 599-604(July-Aug. 1964). Translated from Biokhimiya, 29: 701-6(July-Aug. 1964).

Results are reported from an investigation of the properties of DNA from normal and x irradiated rabbit bone marrow, obtained by the use of various methods. The procedure of fractional precipitation, as well as viscosimetry and electron microscopy, indicate that DNA from irradiated bone marrow at definite periods after irradiation is more highly polymeric than normal DNA. (C.H.)

29919 PYRIDINE NUCLEOTIDES OF RAT-LIVER IN CONDITIONS MODIFYING LIPOGENESIS. S. V. Pande, R. Parvin, and T. A. Venkitasubramanian (Univ. of Delhi). Biochim. Biophys. Acta, 100: 344-51(May 4, 1965).

Starvation for 48 hr and whole body x irradiation (2400 R) had no specific effect on pyridine nucleotides except for a slight increase in $NADP^+$ in starvation and an increase in NADH in both cases when compared with normal values. Refeeding decreased the NADH and increased the total NADP of the liver. The content of NADPH (per g tissue) was similar in all these experimental states. The $NADP^+$ to NADPH ratio was increased by starvation and feeding reversed it again. The NAD to NADP ratio decreased on feeding again. From these results it is inferred that availability of reduced pyridine nucleotides as such may not be critical in lipogenesis and some other reductive biosyntheses in liver. Liver lipids do not show positive correlation with either the levels of pyridine nucleotide or with lipogenesis. (auth)

29920 DISORDERED VERTEBRAL GROWTH FOLLOWING IRRADIATION. H. W. C. Ward (St. Bartholomew's Hospital, London). Brit. J. Radiol., 38: 459-64(June 1964).

Deficient bone growth in the posterior parts of the vertebral bodies is described in a patient 20 years after irradiation for medulloblastoma. The literature on radioinduced disorders of bone growth is reviewed, and the normal development and blood supply of the vertebrae are described. Reduction in bone growth was possibly caused by impaired reproductive integrity of chondroblasts, osteoblasts or angioblasts, or it may have been caused by damage to the blood vessels. Radiation techniques aimed at avoiding bone deformities are discussed. (auth)

29921 INCORPORATION OF C^{14}-ACETATE IN CHOLESTEROL AND FATTY ACIDS OF THE LIVER OF ADRENALECTOMIZED RATS DURING IRRADIATION. K. A. Tret'yakova (All-Union Inst. of Experimental Endocrinology, Moscow). Bull. Exptl. Biol. Med. (USSR) (English Transl.), 57: 696-8(June 1965). Translated from Byul. Eksperim. Biol. i Med., 57: 47-9(June 1964).

The effects of adrenalectomy and irradiation on the incorporation of ^{14}C-acetate into cholesterol and fatty acids were studied in rats that were: adrenalectomized, whole-body x-irradiated, or adrenalectomized and whole-body irradiated. Incorporation of ^{14}C-acetate into both cholesterol and fatty acids was lower in adrenalectomized animals. However, synthesis of both was stimulated by irradiation. When a physiological saline diet was given following irradiation, cholesterol and fatty acid synthesis were increased in both adrenalectomized and intact rats. (H.G.D.)

29922 INFLUENCE OF GAMMA-IRRADIATION ON THE MITOTIC CYCLE OF BONE MARROW CELLS. A. I. Zosimovskaya (Inst. of Radiation, Physics, and Biology, Moscow). Bull. Exptl. Biol. Med. (USSR) (English Transl.), 57: 738-42(June 1965). Translated from Byul. Eksperim. Biol. i Med., 57: 91-5(June 1964).

Radiation effects on the mitotic cycle of bone marrow cells in the case of both myelo- and erythropoiesis was studied in mice exposed to 400 R doses of gamma radiation. Cells were labeled with tritiated thymidine to determine the effects of irradiation on the different periods of the mitotic cycle. Samples were taken at various time intervals from 5 minutes to 120 hrs post-irradiation. Both DNA synthesis and the transition of the cells from the presynthetic into the synthetic period were suppressed. Results indicated that during irradiation there is a change in the production of bone marrow cells in all periods of the mitotic cycle. (H.G.D.)

29923 NUCLEIC ACIDS OF ESCHERICHIA COLI. Litse Ou. Bull. Inst. Chem., Acad. Sinica, No. 10, 1-7(Jan. 1965).

The nucleic acids of Escherichia coli KL-9 were extracted by shaking with 1-mm pyrex glass balls in 0.01M sodium arsenate. The content of nucleic acids in the cells was found to be 11.8%. The composition of the bases of the irradiated strain, which received 28,000 roentgens from x rays did not change as compared with the normal strain. (auth)

29924 EFFECT OF X-RAY RADIATION ON EGG ALBUMIN AND ITS LIGHT SCATTERING PROPERTY. Nganshou Wai and Hao Chu. Bull. Inst. Chem., Acad. Sinica, No. 10, 25-32(Jan. 1965).

A method for calculation of the instrumental constant ϕ of a light-scattering photometer of the Phoenix type is described. Pure crystalline ovalbumin of molecular weight 45,700 was used as a standard material. From the value of ϕ, the apparent molecular weight of fresh egg white was estimated to be 24,000. Detailed calculations are shown in examples. Following irradiation of egg-white solution under x rays of 65 kvp with a dose rate of about 25 r/min/ml, the percentage stability in molecular weight of the protein became 87.7% of the original value after five minutes of irradiation. As the calculated molecular weights increased with the dose, the molecules of egg-white protein might aggregate into larger ones. Ascorbic acid or cysteine was found to have a protective action for the protein to resist against the effect of x rays. (auth)

29925 COMBINED EFFECTS OF X-IRRADIATION AND 3'-METHYL-4-DIMETHYLAMINOAZOBENZENE ON LIVER CELL POPULATION. M. Maini Webber and H. F. Stich (Queen's Univ., Kingston, Ont.). Can. J. Biochem., 43: 811-15(June 1965).

Livers of rats were exposed to 950 rads of x irradiation. The liver cells were then induced to proliferate by the stimulus of partial hepatectomy. The regenerating livers consisted of two cell populations, one of colonies of cells having normal amounts of DNA and the other having abnormal polyploid and aneuploid cells. Regeneration of the liver is attributed to the colonies with normal cells. When 3'-Me-DAB was fed to the x irradiated animals, the behavior of these cell populations was reversed. The multiplication of abnormal cells was favored in the presence of the carcinogen. Changes in the percentage of mitotic irregularities, the mitotic rates, and the proportion of various stages of mitosis that resulted in the altered behavior of cell populations are discussed. (auth)

29926 FORMATION OF CELL COLONIES IN X-IRRADIATED REGENERATING LIVERS OF RATS. M. Maini Webber and H. F. Stich (Queen's Univ., Kingston, Ont.). Can. J. Biochem., 43: 817-28(June 1965).

A high incidence of mitotic irregularities was observed when x irradiated livers were induced to regenerate after a partial hepatectomy. Mitotic irregularities resulted in the formation of a heterogeneous cell population. As re-

generation proceeded, the liver was found to be composed of two different cell populations: one consisting of polyploid and aneuploid cells and incapable of giving rise to many descendants, and another consisting of apparently normal cells and capable of extensive proliferation which resulted in the formation of cell colonies. The regeneration of liver is mainly attributed to the cell colonies. No tumors appeared in the liver. These results demonstrate that a heterogeneous cell population of a precancerous lesion does not necessarily lead to the formation of a neoplasm. A selection pressure can be considered as necessary to favor the multiplication of cells with abnormal chromosome complements over that of cells with normal complements, as is seen in the livers of rats fed a chemical carcinogen. However, in the case of x irradiated livers, normal cells seem to be favored. (auth)

29927 EVOLUTION OF THE RESTORATION OF THE MEDULLARY CELLS AFTER LOCALIZED AND GENERALIZED IRRADIATION IN THE RAT. C. Michaud, S. Manuel, and A. Chevallier (Faculte de Medecine, Strasbourg). Compt. Rend. Soc. Biol., 158: 2161-6(1964). (In French)

Rats exposed to localized and whole-body irradiation at doses of 100 or 500 R were examined to determine the time requirements for the restoration of the medullary cells. The animals were sacrificed at times from 24 hours to 21 days after irradiation. The evolution of the lymphocyte, normoblastic, and myelocytic series was determined and the results are tabulated. It was concluded that the lymphocyte series behaves in a completely different manner after whole-body irradiation as opposed to localized irradiation. In the case of the myelocytic and normoblastic series the responses are very analogous. (J.S.R.)

29928 EFFECTS OF LOCAL IRRADIATION ON THE GROWTH OF THE SARCOMA I IN THE CBA MOUSE. P. Chevalier (Universite, Liege). Compt. Rend. Soc. Biol., 158: 2207-10(1964). (In French)

The radiosensitivity of sarcoma J in mice was studied by determination of the growth modifications under single irradiation at doses from 500 to 4000 R. At doses below 1000 R no effect was observed on the growth. With doses from 1000 to 4000 R a progressive tumor regression was observed. For tumors that do not regress, the arrest of the growth and the increase of the survival time are functions of the dose absorbed. Only at 4000 R was there a definiative regression in all the animals. The sarcoma J is then less radiosensitive than the sarcoma 180 for which there is 100% regression for a dose of 2000 R. (J.S.R.)

29929 CHROMOSOMIC ANOMALIES IN THE C 57 BL MOUSE AFTER INJECTION OF TRITIATED THYMIDINE. L. E. Lagneau and D. J. Mewissen (Université, Brussels). Compt. Rend. Soc. Biol., 158: 2210-12(1964). (In French)

The effect of low doses of tritiated thymidine on the morphology of the chromosomes of the C 57 BL mouse were studied. Doses of 0.5, 0.9, 1.5, and 2 $\mu c/g$ of body weight were administered subcutaneously to new born mice. In place of the mitotic chromosomes, achromatic vesicular images were observed on the tritiated molecules detected by autoradiography. (J.S.R.)

29930 A FREAK DWARF MUTANT INDUCED BY FAST NEUTRON IN RICE. B. N. Sahay (Sugarcane Research Inst., Bihar, India). Current Sci. (India), 34: 222-3(Apr. 5, 1965).

The features of a freak dwarf mutant resulting from the irradiation of dry rice seeds (As. 35) with fast neutrons are summarized. (D.C.W.)

29931 STUDY OF THE MORPHOLOGIC CHANGES AT MICROSCOPIC LEVEL PRODUCED BY Co^{60} GAMMA IRRADIATION IN FAGUS SILVATICA L. WOOD. S. Bonotto (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Energia Nucl. (Milan), 12: 333-6(June 1965). (In Italian)

The results of studies made on the effects of gamma irradiation in beech wood at a microscopic level, in particular for investigating the degradation of the cellular walls, are reported. (auth)

29932 SURVIVAL OF, AND CHANGE IN, EHRLICH ASCITES TUMOUR CELLS FOLLOWING IRRADIATION WITH LARGE DOSES OF X- AND UV RADIATION. V. Drasil and Vera Juraskova (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 11: 103-8(1965).

Survival of diploid and tetraploid Ehrlich ascites tumor (EAT) cells was studied in the peritoneal cavity of mice. The cells were preirradiated with a dose of 4,000 to 100,000 rad x rays or with uv radiation in doses corresponding to eight times D_{37} for diploid EAT. Diploid cells disappeared from the peritoneal cavity faster than tetraploid cells. The survival time after uv irradiation was shorter than after x radiation. DNA was synthesized in the irradiated cells up to the third day after irradiation, when the amount of DNA reached, on an average, double the normal value per cell. RNA synthesis was still found in all cells on the eighth day after irradiation with 100,000 rad. The total volume of cells irradiated with x rays increased on the first 4 to 5 days after irradiation up to 15 times the original value. In cells irradiated with uv radiation, small volume changes were found only in the tetraploid form of EAT. The volume of the diploid form did not increase after uv irradiation. (auth)

29933 THE EFFECT OF RADIATION ON DEOXYRIBONUCLEOPROTEINS IN ANIMAL TISSUES. I. THE TIME COURSE OF THE RELEASE OF DEOXYRIBOPOLYNUCLEOTIDES IN DIFFERENT TISSUES AFTER IRRADIATION IN VIVO. M. Skalka, Jitka Matyasova, and Vera Chlumecka (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 11: 113-22(1965).

In mice and rats, irradiation is followed by an increase in the amount of free deoxyribopolynucleotides in the spleen, thymus and bone marrow, which reaches maximum values 4 to 8 hrs after irradiation. Comparative experiments with the tissues of different animals (mice, rats, guinea-pigs, chicks) showed that significant amounts of deoxyribopolynucleotides were released only in lymphatic and hematopoietic tissue (thymus, spleen, bone marrow). Other radiosensitive tissues (testes, regenerating liver) and radioresistant tissues did not respond. The release of deoxyribopolynucleotides in the thymus, spleen and bone marrow is the outcome of direct irradiation of the tissue, since the increase in tissues shielded during irradiation was negligible. (auth)

29934 THE ACID-SOLUBLE DEOXYRIBOSIDE AND DEOXYRIBOTIDE POOL AND DEOXYRIBONUCLEIC ACID SYNTHESIS IN HAEMATOPOIETIC TISSUES OF NORMAL AND IRRADIATED ANIMALS. L. Benes, J. Soska, and Emilie Lukasova (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 11: 123-33 (1965).

The relationship between the acid-soluble deoxyriboside and deoxyribotide concentration and DNA synthesis in the spleen and thymus was studied in normal and irradiated rats and in guinea-pig bone marrow. Deoxyribo-compounds were determined microbiologically and DNA synthesis was studied by means of autoradiography. The composition of acid-soluble spleen and thymus extracts differs. The main component of spleen extract is deoxycytidine, while in thymus extract it is thymidylate (the degree of phosphorylation was not differentiated). Disproportion between the concentrations of purine and pyrimidine derivatives and between the concentrations of deoxyribosides and deoxyribotides was found in both tissues. Stimulation of DNA synthesis in the reticular cells of bone marrow by exogenous pyrimidine deoxyribosides and deoxyribotides was found in vitro; the most effective was thymidine monophosphate. A correlation between the concentration of free deoxyribo-compounds in bone marrow in vivo and DNA synthesis in the reticular cells was also described in irradiated guinea pigs and guinea pigs whose hematopoiesis was stimulated by bleeding. (auth)

29935 ATTEMPT TO INFLUENCE DIFFERENTIATION OF THE STEM CELLS OF BONE MARROW ADMINISTERED TO IRRADIATED MICE. L. Tkadlecek and Vera Juraskova (Purkyne Military Inst. of Medical Research and Postgrad-

uate Study, Hradec Kralove, Czechoslovakia and Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 11: 134-9(1965).

The effect of the injection of Pyrifer and anemic plasma was studied on the number and character of colonies of hematopoiesis in mouse spleens nine days after exposure of the animals to 650 R. One day after irradiation, half the mice were injected with syngeneic bone marrow. After the administration of anemic plasma, no differences were observed as compared with the controls. After Pyrifer alone, a significantly larger number of small white colonies was observed. The spleens of mice to which bone marrow was administered after the intraperitoneal injection of Pyrifer contained a statistically significantly larger number of large colonies of myelopoiesis. The authors' explanation of these findings is that, following the injection of Pyrifer, substances with a stimulant effect on the regeneration of white hematopoiesis are formed in the organism after irradiation; in their opinion, the basis of this phenomenon is that Pyrifer influences the direction of differentiation of stem cells into white hemoblasts. (auth)

29936 TO THE PROBLEM OF INDIVIDUAL RADIOSENSITIVITY OF BONE MARROW. Z. Karpfel, Blazena Koukalova, Jana Cincarova, and Zora Papezova (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 11: 140-6(1965).

The prognostic significance of determination of the incidence of spontaneous chromosomal aberrations for the postirradiation proliferation of bone marrow was studied. Mice of the inbred strain C57Bl were killed by decapitation and the mitotic index, the incidence of spontaneous aberrations and the relative distribution of the various phases of mitosis were determined in the marrow of one femur. The marrow of the other femur was irradiated in vitro with an exposure of 191 R and was then cultivated for three days in vivo, in diffusion chambers in the peritoneal cavity of mice of the same strain and sex. After three days the chambers were removed and the same mitotic indicators were determined in the bone marrow. This gave preirradiation values and the corresponding postirradiation values from the same animal. The results showed that the bone marrow of individuals with a large number of spontaneous aberrations was characterized three days after irradiation by lower mitotic activity, a higher incidence of metaphases among the mitotic figures and a higher incidence of postmetaphase chromosomal aberrations. The interrelationships between the given indicators are discussed. (auth)

29937 RELATIONSHIP OF RADIOSENSITIVITY TO THE RATE OF GROWTH. L. Novak, M. Pospisil, and B. Hosek (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 11: 147-55(1965).

Changes in the radiosensitivity of Wistar strain rats (mortality up to the 30th day) irradiated with a whole body exposure of 600 R were studied in relation to age, within limits of 7 to 25 weeks. Respiratory metabolism was also studied prior to irradiation. The results showed a phase of elevated radiosensitivity within the given time limits, corresponding to the period of the maximum rate of growth (9 to 10 weeks). Gaseous exchange values were evaluated by a method that consists in calculating the difference between theoretical and actual oxygen consumption (ΔO_2). Maximum ΔO_2 values, indicating a state of imbalance of metabolic-energy processes in the organism, were found during this phase of elevated radiosensitivity and maximum rate of growth. The interrelationships of the various parameters are discussed. (auth)

29938 RADIATION LETHALITY AND CIRCADIAN RHYTHMICITY IN MICE. J. F. Spalding and Paul McWilliams (Los Alamos Scientific Lab., N. Mex.). Health Phys., 11: 647-51(July 1965).

Two methods were used to study the influence of circadian rhythmicity on radiosensitivity in mice as a factor in acute radiation effects studies. The results suggested the presence of diurnal differences in radiosensitivity; however, these slight differences were neither consistent nor significant. It was concluded that circadian rhythmicity is not a primary factor in studying whole-body effects from acute radiation exposure. (auth)

29939 IMMUNOLOGIC COMPETENCE AND PHAGOCYTOSIS IN GERMFREE ANIMALS WITH AND WITHOUT STRESS. Heinz Bauer (Mt. Sinai Hospital, New York), Richard E. Horowitz, Kenneth C. Watkins, and Hans Popper. J. Am. Med. Assoc., 187: 715-18(Mar. 7, 1964).

To evaluate the role of the microflora in lymphatic tissue reactions, a study was undertaken of lymph nodes and spleens of animals which had never been exposed to living microörganisms. These experiments included a comparison of lymph nodes which in conventional animals drain organs rich in bacteria, such as the pharynx, larynx, and intestinal tract, with nodes from the extremities which are usually not exposed to microörganisms. Comparison between the spleens and lymph nodes draining the intestine of germfree and conventional mice revealed a similar gross appearance and weight, but there was a considerable reduction, but not absence, of immunologically competent cells in the germfree animals. This applied to the immature hemocytoblasts as well as to mature plasma cells. The response to immunologic challenge of bacterial origin was studied by the injection of formalin-killed Escherichia coli into the foot of germfree and conventional mice. The underdeveloped immunologic system of the germfree animal was capable of an equal though slightly delayed response to the bacterial antigens, and therefore little advantage, if any, is conferred upon the immune response by prior exposure to bacteria. In contrast, the macrophage system, which showed no structural differences in germfree and conventional mice, was functionally less capable in the germfree mice, as suggested by slower intracellular digestion of phagocytized bacteria. The response to whole-body irradiation was also studied. After receiving 550 R in a single dose of whole-body x irradiation, all germfree mice survived but 35% of the conventional mice died between the second and sixth day after irradiation. In all animals the most striking change in the early post-irradiation period was a marked weight loss of all lymph nodes and spleen owing to the virtually complete destruction of lymphocytes. Supporting cells, macrophages, and mature plasma cells survived radiation apparently intact. In the conventional mice by five days after irradiation and in the germfree mice by ten days after irradiation, most lymph nodes showed an immune response. As in the mice injected with E. coli, the reaction began with the appearance of hemocytoblasts which were present first in the cervical nodes, then in the mesenteric and axillary nodes and spleens; their relative frequency also conformed to this order. Labeling with tritiated thymidine established that these cells were newly formed. Ten to 15 days after irradiation, the number of hemocytoblasts reached its peak and increasing numbers of immature and mature plasma cells appeared. The post-irradiation spontaneous immune response in lymph nodes and spleens of germfree mice is attributed to antigens derived from food, feces, or tissue breakdown products. A similar response in conventional mice begins earlier and is more marked. These findings show that structure and function of lymphatic tissue of mice, those under stress and those not, are modified by prior experience with a microbial flora. (BBB)

29940 ROLE OF CYTOSINE PHOTOPRODUCTS IN ULTRAVIOLET INACTIVATION OF BACTERIOPHAGE T1. Walter Sauerbier (Universitat, Cologne). J. Mol. Biol., 10: 551-3(Dec. 1964).

To determine whether photodestruction of cytosine is sufficiently high to match the lethal hits, phage T1 labeled with ^3H-cytosine was irradiated. The distribution of radioactivity in a butanol-water chromatogram of hydrolysates of unirradiated T1 revealed little activity at the starting point of chromatography, the majority of activity at the position of cytosine, and a little unexpected activity at the position of thymine. This activity distribution was confirmed with the solvent system isopropanol-HCl-water. Following uv irradiation of T1 to about 6×10^4 erg/mm^2, the distribution of radioactivity changed to the pattern showing that significant amounts of radioactive material remain around the

starting point, a position where pyrimidine dimers and uracil appear. The large reduction of the thymine peak was unexpected and shows removal of more than 50% of the thymine. This effect is confirmed by the results of isopropanol-HCl-water chromatography. Different fractions of cytosine were converted to photoproducts in T1 by various doses of uv. Apparently a photosteady state is reached between 1.2×10^4 and 3.6×10^4 erg/mm^2 suggesting the existence of a cytosine photoproduct, which upon further uv irradiation reverts to cytosine. Comparison of the ratios of cytosine converted to photoproducts per T1 particle to lethal hits per T1 particle shows that, as with thymine dimer, the majority of the cytosine photoproducts are also non-lethal. (BBB)

29941 THE MANAGEMENT OF RADIATION-INDUCED DAMAGE TO THE BOWEL. David G. Ashbaugh and J. Cuthbert Owens (Univ. of Colorado, Denver). J. Roy. Coll. Surgeons Edinburgh, 10: 48-55(Oct. 1964).

Intestinal injury resulting from radiotherapy and its treatment were surveyed in 54 women, and classified in three groups according to severity. In Group I (8 patients), symptoms were relatively mild and damage to the bowel was minimal. Presenting complaints were rectal pain, tenesmus, diarrhea, and constipation. All patients responded to nonoperative management and became asymptomatic. In Group II (10 patients), symptoms were similar, but the illness was more severe and protracted. Rectal bleeding was frequent and patients did not respond to nonoperative treatment as promptly as Group I. Strictures of the rectum or sigmoid developed in six cases, but in no case was operation required. In Group III (36 patients), all had severe and incapacitating symptoms and all required surgical intervention. There were 24 strictures and 33 instances of fistula formula, and 87 operations were performed in attempts to relieve the problems caused by the radiation damage. Morbidity and mortality were significantly higher in this group: about 20% died from the indirect effects of radiation damage to the bowel. Certain patients appeared to be more sensitive to radiation than others. Given equal dosage, and with other factors being relatively equal, some patients developed severe bowel damage and others none at all. For mild cases of chronic stricture, nonoperative treatment may suffice. The bowels are regulated and dilatation may give some symptomatic relief. Most patients require prompt surgical intervention to prevent or treat the severe complications of this disease. In colon and rectum disease, the first and most important procedure is a diverting colostomy. Once colostomy has been performed, further operations are inadvisable until the local inflammatory reaction has completely subsided and max healing has taken place (from 3 to 6 months). When the local reaction has subsided and recurrence of carcinoma has been excluded, several courses may be followed, firstly, resection of the involved area of the rectum or sigmoid, when the lesion is very localized. The second alternative is to leave the patient with a permanent colostomy. The third alternative is pelvic exenteration, which should be reserved for those patients with proven recurrent carcinoma, not for radiation injury alone. Small bowel lesions, while less common, carry a higher mortality. Early surgery is required and extensive damage and resection will frequently lead to severe nutritional problems. (BBB)

29942 INFLUENCE OF THE THYMUS ON ALLOGENIC SKIN GRAFT SURVIVAL AFTER BODY IRRADIATION. Peter M. Braunstein (Univ. of California Medical Center, San Francisco). J. Surg. Res., 5: 137-40(Mar. 1965).

The effect of prior thymectomy and irradiation on allogenic skin graft survival was studied in adult rats and rabbits. The effect of previous appendectomy and thymectomy was studied in the rabbit, because of the previous demonstration that the appendix as well as the thymus is necessary for the development of immunologic competence. Allogenic skin graft survival was used as an indicator of the restoration of immunologic competence. Total-body irradiation (280 R) in rats caused a prolonged skin graft survival time when compared to the sham-irradiated controls. Thymectomy alone did not prolong homograft survival. Thymectomy combined with total-body irradiation did not extend survival time beyond that obtained with total body irradiation alone. In rabbits, as in rats, irradiation (800 R) caused a significant prolongation of allogenic skin graft survival when compared to sham-irradiated controls. The addition of previous thymectomy, or thymectomy combined with appendectomy, to irradiation did not prolong skin graft survival beyond that achieved with total-body irradiation alone. In a third group of animals, thymectomized and appendectomized rabbits were irradiated after lymph nodes were excised from extremities which were shielded during irradiation. By this means it was expected that autologous bone marrow cells surviving in these extremities would provide hematopoietic restoration, while lymphoid tissue had been destroyed, preventing intervention of lymphoid cells in homograft rejection. In this group of rabbits, previous thymectomy, appendectomy, and hind limb lymph node excision did not prolong skin graft survival beyond that achieved by irradiation alone. There was no difference in skin graft survival in this series of animals even though the irradiation was 1200 R compared to the 800 R used in the other group. All animals survived over three weeks after irradiation. A control group of animals, which received 1200 R without shielding of legs, all died within 10 days of irradiation. Microscopic examination of the spleen in both rats and rabbits at 2, 14, 28, and 42 days after irradiation revealed marked depletion of lymphoid elements at two days with complete regeneration of the lymphoid elements in all groups at 42 days. In contrast to previous findings in mice, the present investigation in adult rats and rabbits suggests that the thymus is not essential for the recovery of the ability to reject allogenic skin grafts and the repopulation of lymphoid structures after irradiation. The excision of the appendix and thymus in rabbits did not decrease the ability to reject allogenic skin grafts after irradiation over that accomplished by irradiation alone. Thus the objective of producing extended allogenic skin graft survival was not achieved despite the fact that very large doses of irradiation were given. This may have been due to the fact that rabbit bone marrow may contain sufficient numbers of competent cells to repopulate lymphoid structures in the absence of the thymus. Stem cells originally from the thymus or appendix, resistant to this dose of irradiation, may reside throughout the body. (BBB)

29943 BIOLOGICAL SIGNIFICANCE OF PIGMENTS OF MYCOBACTERIA. III. RESISTANCE TO ULTRAVIOLET IRRADIATION OF VARIOUS UNCLASSIFIED MYCOBACTERIA. Sumio Tsukamura (Nagoya Univ. School of Medicine, Japan). Japan. J. Tuberc., 12: 7-9(July 1964).

All the mycobacteria tested were killed by uv irradiation, showing a linear relation between the radiation dose and survival at the early stage of irradiation. There were significant differences among the groups of unclassified mycobacteria. Photochromogens (Forbes-84 and Bostrum D-35 strains) were the most sensitive to uv light, nonphotochromogens (N-100616 and N-0121326) intermediately sensitive, and scotochromogens (SP-5 and SP-6) the least sensitive. That scotochromogens were more resistant to uv irradiation than nonphotochromogens and photochromogens suggests that the carotenoid pigments present in the scotochromogens protected these bacteria from injurious action of uv light, and that this protective action is of biological significance. The fact that photochromogens were the most sensitive to uv light is not in contradiction. Photochromogens cannot produce pigments during such a short time as the duration of irradiation. Production of pigments in photochromogens requires at least several hours or a day, and an active metabolism of bacterial cells. Therefore, the bacteria die before pigment production is begun. However, it would be expected that pigment production be useful for the protection to mild light exposure, such as might permit pigment production before serious injury of bacterial cells. The pigments of unclassified mycobacteria, photochromogens, and scotochromogens, are found in the lipid fraction of bacteria, which is extractable with petroleum-ether or boiling ether-alcohol so-

lution. It is probable that these pigments, combined with lipids, are present in the surface layer of bacterial cells and serve to protect the cells against the injury of uv light. (BBB)

29944 THE EFFECT OF X RAYS ON THE HEALING OF SKIN TRANSPLANTS. P. Wilfingseder, E. Blum, and E. Ruckensteiner (Chirurgische Universitatsklinik, Innsbruck). Klin. Med. (Vienne), 18: 170-4(1963). (In German)

Healing of free skin transplants depends, in part, on development of capillaries in the corium before the epidermis undergoes ischemic autolysis. The time required for this is roughly proportional to the thickness of the transplant. In thin transplants revascularization takes place between 24 or 48 hr. In large transplants it may take as long as 5 days, and ulcerations or necrosis may appear in areas where a blood supply has not developed. In order to alter the metabolic state of the transplant and extend the period available for capillary development, rabbit skin transplants were stored at 37° for 1 to 5 days in sterile nutrient solutions. These were transplanted to skin or experimental rabbits. Twenty six of the transplants were irradiated once with 1000 R of x ray. Ten other similar transplants were not irradiated for use as controls. Four transplants showed fungus growth, and three were gnawed off by the animals. Of the unirradiated transplants only those that had been transplanted on the first or second day survived. Irradiated transplants survived even when they had been transplanted after 5 days storage. After four weeks almost all of the irradiated transplants were entire, or at least partially healed. (BBB)

29945 HUMORAL STIMULATION OF THE RELEASE OF GRANULOCYTES FROM THE BONE MARROW BY THE SPLEEN. J. G. Gostomzyk, C. Feeser, and G. Ruhenstroth-Bauer (Max-Planck-Institut fur Biochemie, Munich). Klin. Wochschr., 42: 231-2(Mar. 1, 1964). (In German)

Release of granulocytic elements from bone marrow is observed only in intact animals after whole-body irradiation, or after selective irradiation of the exteriorized spleen. Splenectomized animals do not show this response. An extract of spleen from rats was dissolved in physiological saline and injected intravenously into other rats that had been splenectomized one day previously. The pattern and numbers of cells contained in the blood of these animals was very similar to that in animals subjected to selective irradiation of the spleen with 800 R of x ray. In order to identify the active factor contained in the spleen extract, it was centrifuged, dialyzed, and lyophilized. The lyophilized dialysate was passed through a chromatographic column. The effluent was ninhydrin positive, and had a molecular weight less than 10000. It was active in the pH range 5.5 to 7. Enzymatic studies indicated that the active factor was a peptide with an acid-labile structure or components. Its activity was destroyed by incubation with neuraminidase at 37°C, indicating that it contained neuraminic acid. Its chemical properties were somewhat parallel to those of erythropoietin. The authors suggest the name granulomovin for this factor which releases granulocytes from bone marrow. (BBB)

29946 BIOLOGICAL EFFECT OF COSMIC RADIATION IN THE EVENT THAT SOLAR FLARES OCCUR ON THE EARTH TO MOON ROUTE IN MODEL EXPERIMENTS. V. S. Morozov, V. V. Antipov, B. I. Davydov, N. N. Dobrov, P. P. Saksomov, and V. S. Shashkov. Kosmich. Issled., 3: 325-9(Mar.-Apr. 1965). (In Russian)

The necessity and possibility in principle of evaluating the biological effects of ionizing radiation under the conditions of a simulated radiation situation during a flight to the moon, with consideration of the appearance of chromospheric flares, are examined. The results of preliminary experiments in simulating a brief solar flare under laboratory conditions are cited. (tr-auth)

29947 SEASON AND TERATOLOGY. Lars Jacobsen (Copenhagen Univ., Denmark). Lancet, 1: 437(Feb. 20, 1965).

Results of a teratologic investigation on mice, carried out with small doses of ionizing radiation as the teratologic agent, suggest a certain variation in the susceptibility to radiation as regards induction of resorption and litter size. In the experiments described, on the eighth day of pregnancy, female mice of the HC strain were exposed to whole-body irradiation with doses of 5, 20, and 100 R. The number of fetal anlages irradiated varied, as shown by the number of young and the number of resorptions registered immediately before the anticipated delivery. There was a summer group, where conception occurred between Apr. 1 and Sept. 30, and a winter group, between Oct. 1 and Mar. 31. The results showed that after irradiation, even with 5 R, there was a higher percentage of resorptions, while as regards litter size a definite effect was only observed at a dosage of 100 R. As regards both the incidence of resorption and litter size, however, there was a seasonal difference. This suggests that the teratogenic agent unmasks a latent seasonal variation, which becomes more apparent by a greater irradiation effect in winter. In the 5-R group the higher winter incidence of resorption was statistically significant at the 5% level. The seasonal variations in the other experimental groups (20-R and 100-R) all showed the same tendency but were not statistically significant. If all irradiated mice were combined, the greater frequency of resorptions in the winter group was very highly significant. Further examination of a possible seasonal influence on pathoembryologic processes is therefore desirable. The results indicate that season of birth should be considered in teratologic studies when experimental and control groups are compared. (BBB)

29948 TWO TUMORS OF THE THYROID GLAND IN CHILDHOOD. A. E. Hensen, H. Van Ravensteyn, W. Smeets, and W. H. H. Tegelaers (Binnen Ziekenhuis, Eindhoven, Netherlands). Maandschr. Kindergeneesk., 31: 348-71(Oct. 1963). (In Dutch)

A review is presented of the literature published during the past ten years on malignant and potentially malignant tumors of the thyroid in children, and of the effect of previous therapeutic irradiation on their pathogenesis. In addition, two new cases of thyroid cancer in childhood are described, one of which included a history of radiation exposure. This case concerns a carcinoma of the papillary type in a 5-yr-old boy. Metastatic spread was already present in a cervical lymph node close to the tumor. One clinical symptom dominated: a persisting nodule in the lateral cervical region. This boy had been treated by x rays four years previously for recurring adenoiditis, otitis, and catarrh. He had thus been exposed to three 150-R doses per field twice a week over the eustachian tube with 450 R to the left and 300 R to the right ear. The thyroid gland received an estimated dose of 200 R. Carcinoma diagnosis was made four years later by puncture of the nodule and histological examination. This procedure was immediately followed by radical surgery; a scanning diagram of the thyroid after ^{131}I showed poor uptake in the malignant region. The metabolic defect of the thyroid cells in the cancer region, resulting in the production of an abnormal protein, is discussed, as well as the use of ^{131}I in treatment of thyroid cancer. Postoperative treatment was started with large doses of Thyranon to interfere with the secretion of TSH by the hypophysis. Three years after surgery the boy is still in excellent condition, without apparent metastatic lesions. The second case concerns a two-month old boy with a teratoid tumor of the thyroid gland. Since this kind of tumor can sometimes become malignant, it was completely removed, together with parts of the normal thyroid gland. After 14 years the boy is still in good health. Prior irradiation was not implication in this case, but the possibility that it was an etiologic agent in the first case is considered. (BBB)

29949 CHANGES OF THE BLOOD IN IRRADIATION OF DIFFERENT REGIONS OF THE BODY. V. K. Polenko and G. K. Khisamutdinov (Budenko Main Military Hospital, Moscow). Med. Radiol., 10: No. 4, 24-30(Apr. 1965). (In Russian)

Hematological data in 484 patients subjected to radium therapy for tumors, thyrotoxicosis, syringomyelia and thrombophlebitis of the lower extremities were studied.

The degree of hematopoiesis inhibition depends mainly upon the integral dose of absorbed energy and on the individual peculiarities of the organism. Besides, there was found a relationship between changes of the leukocyte formula and physiological importance and functional state of irradiated organs and systems. In particular, during irradiation of the brain there is a prevalent development of neutropenia, of the chest and abdomen—lymphocytopenia, of the hypophysis—eosinophilia, and of the thyroid gland—eosinopenia. Absolute monocytosis was observed only in irradiation of the thyroid gland and monocytopenia in irradiation of the spinal cord. (auth)

29950 THE DEVELOPMENT OF ACUTE LEUKEMIA IN A CHILD AFTER RADIUM THERAPY OF MULTIPLE SMALL ANGIOMAS OF THE SKIN. T. D. Mirimova. Med. Radiol., 10: No. 4, 30-2(Apr. 1965). (In Russian)

A case history is described of a girl who developed leukemia 4½ years after gamma therapy (^{60}Co applications) for small angiomas of the skin in the region of the left cheek, occiput, anterior abdominal wall, and large toe. (auth)

29951 THE REMOTE SEQUELAE OF X-RAY THERAPY OF THE LUNGS IN CHILDREN. V. P. Shurygin (Leningrad Medical Inst. of Pediatrics). Med. Radiol., 10: No. 4, 32-7(Apr. 1965). (In Russian)

Results are reported of examinations performed in 30 children subjected to x-ray therapy of the lungs and adjacent regions. Clinico-roentgenological observations were carried out during treatment, as well as in periods ranging from 1 to 4 years after irradiation. Postmortem data were studied in 8 deceased children. Radiation lesions were observed in all children, their severity depending on the total dose and time of observation. Radiation affection of the lungs in children proved to be more compensated than in adults. Roentgenological signs of radiation lesions are not specific and consist in changes of fibrous nature in the pulmonary tissue and pleura. (auth)

29952 THE STATE OF THE CARDIOVASCULAR SYSTEM IN PATIENTS WITH UTERINE CERVIX CARCINOMA AT LATE PERIODS AFTER RADIUM THERAPY. E. I. Vasil'eva and S. V. Strutsovskaya (Roentgen-Radiological Scientific Research Inst., Moscow). Med. Radiol., 10: No. 4, 38-42(Apr. 1965). (In Russian)

Investigations are reported of the functional state of the cardiovascular system in 32 patients with uterine cervix carcinoma at late periods after combined radium therapy. It is concluded that irradiation of the minor pelvic region in patients with uterine cervix carcinoma causes an indirect functional disturbance of the cardiovascular system. After radium therapy disturbances in the endocrine, hematopoietic and nervous system cause shifts in the functional state of the cardiovascular system. Regardless of the frequency and severity of cardiovascular damage, patients were physiologically normal at times remote to therapy. (H.G.D.)

29953 THE DISTRIBUTION OF COLLOIDAL RADIOGOLD AND HISTOLOGICAL CHANGES IN THE TISSUES IN ITS ADMINISTRATION INTO THE ABDOMINAL CAVITY. V. I. Samokhvalov, S. A. Kalashnikov, and V. I. Ratsiborskii (Kirov Military Medical Academy, Leningrad). Med. Radiol., 10: No. 4, 49-53(Apr. 1965). (In Russian)

When ^{198}Au is injected into the abdominal cavity, spread beyond the abdominal cavity is insignificant. The greatest dystrophic processes with subsequent development of connective tissue were in the peritoneal membranes. In lymph nodes completely replaced by tumors, no signs of radiation effect were found. (H.G.D.)

29954 FEATURES PECULIAR TO DEGENERATION AND REGENERATION OF NERVE TRUNKS IN COMBINED INJURY (EXPERIMENTAL RESEARCH). Ya. I. Ryss. Med. Radiol., 10: No. 4, 59-62(Apr. 1965). (In Russian)

Effects of irradiation combined with surgery on degeneration and regeneration of the sciatic nerve were studied in dogs affected with acute radiation sickness. Motor disorders of the operated limb were similar in experimental and control animals, whereas trophic changes were more frequent and pronounced in irradiated dogs. Combined radiation injuries inhibited processes of degeneration and regeneration of nerve fibers, particularly at early periods after the operation. Newly formed nerve fibers in irradiated animals were thinner, shorter, and fewer in number than in control dogs. (H.G.D.)

29955 THE STATE OF WALLS OF LARGE BLOOD VESSELS IN ACUTE RADIATION SICKNESS. K. B. Tikhonov and I. A. Chalisov (Kirov Military-Medical Academy, Leningrad). Med. Radiol., 10: No. 4, 62-5(Apr. 1965). (In Russian)

By means of angiography it is established that in acute radiation sickness there occurs a sharp constriction of large arteries. Histological investigations disclosed that in comparison with small branches, arterioles and capillaries, the walls of large arteries remain unchanged. All the arterial and elastic membranes are normal and the structure of the walls is distinct. The data point to the fact that constriction of large arteries is functional and occurs at the expense of contraction of circular muscular fibers of the median membrane. (auth)

29956 EXPERIMENTAL DATA CONCERNING THE ACTION OF IONIZING RADIATION ON THE BONES OF GROWING ANIMALS. V. V. Kholin (Kirov Inst. for Medical Graduate Work, USSR). Med. Radiol., 10: No. 4, 75-9 (Apr. 1965). (In Russian)

Data from 45 references are reviewed. (IIC-M.G.)

29957 ON THE RADIATION SENSITIVITY OF EXTRAMEDULLARY HEMATOPOIESIS. G. V. Hevesy, D. Lockner, and K. Sletten (Univ. of Stockholm). Med. Welt, No. 10, 455-60(Mar. 7, 1964). (In German)

The effect of radiation on blood cell formation was studied in fish (tench), which have no marrow and form erythrocytes in the spleen or kidney. This enabled the study of radiosensitivity of blood-forming organs other than bone marrow. The effect of ^{60}Co γ radiation doses of 150 to 2000 rad was investigated in fish weighing 100 to 200 g, maintained at 18 or 5°C. Injected ^{59}Fe was used to follow erythropoiesis, 70% of the injected amount being taken up into erythrocytes after 20 days in fish at 18°C. A significant depression of ^{59}Fe uptake by red cells occurred after 750-rad irradiation, whereas maximum depression was noted 7 days after 1500-rad doses. This dose also markedly decreased red cell counts, hemolysis of erythrocytes as well as depression of hematopoiesis being responsible. This was shown by the fact that fish blood cells, unlike those of mammals, are very sensitive to ionizing irradiation, 4000-rad doses caused marked hemolysis of fish blood cells irradiated in vitro. A 250-rad in vivo dose reduced total leukocytes and lymphocytes to 50% of normal in fish kept at 18°C, and even 150 R caused detectable changes in levels of circulating cells. Hemoglobin synthesis took place more slowly at 5° than 18°; at 5° only 4% of injected ^{59}Fe was incorporated in hemoglobin, and this incorporation was not affected by 10,000-rad irradiation at 5°C. Tench erythrocytes also contain nonhemoglobin-bound Fe, and after in vitro irradiation of the cells this nonhemoglobin Fe is increased. It is concluded that extramedullary erythropoiesis is relatively radioresistant. (BBB)

29958 DELAYED INTESTINAL LESIONS AFTER TREATMENT OF THE PELVIC REGION BY PHYSICAL AGENTS. M. F. d'Huart. Mem. Acad. Chir., 90: 501-4 (May 20, 1964). (In French)

Observation I: A female patient, born in 1901, underwent a total hysterectomy for ovarian cancer in 1950. She received 12,600 R radiotherapy. In 1956 she suffered an intestinal obstruction, gas, nausea, and vomiting. Constrictions of the ileum were found with dilatation of the upper loops. A resection was performed, but no tumor was found. There were regions of atrophied mucous membrane with submucosa fibrosis, interstitial edema, and a reduction of blood vessel lumens due to hyaline thickening. The patient recovered. Observation II: A female patient, born in 1912, received 11,180 R for cervical cancer in February 1959. In August, an acute occlusion of the small intestine appeared, caused by a constriction of the ileum.

The adjacent mucosa showed ulcerations and numerous telangiectasia. A resection and an end-to-end enteroanastomosis were performed and the patient recovered. Observation III: A female patient, born in 1910, received an unknown dose of radiation for treatment of a cervical lesion in 1951. At intervals, beginning in 1956, she suffered cramps, hypogastritis, diarrhea, and nausea. She came for treatment in 1959. An examination revealed anemia and a marked constriction of the middle ileum. A circular band of scar tissue was found, as well as ulcerations and telangiectasia. After surgery, mild diarrhea remained, but the anemia did not reappear. Observation IV: A female patient, born in 1905, underwent a hysterectomy in 1955 and received 13,200 R. In 1960 she was examined and found to have lesions characteristic of postradiotherapy colitis. A resection of the sigmoid colon with end-to-end anastomosis was performed and the patient recovered. Lesions of the small intestine are rarer than lesions of the colon, although the mucosa of the small intestine is very radiosensitive. Diagnosis is difficult with a recurrent or metastatic tumor. (BBB)

29959 ARE SISTER CHROMATID EXCHANGES SISTER STRAND CROSSOVERS OR RADIATION-INDUCED EXCHANGES? Sheldon Wolff (Oak Ridge National Lab., Tenn.). Mutation Res., 1: 337-43(Dec. 15, 1964). (ORNL-P-104)

From experiments that gave the ratio of twin sister strand exchanges to single sister strand exchanges in labeled chromosomes of the second division following labeling, Taylor had found that the individual units of chromatids exhibited polarity. It was thought that the events that led to these exchanges were sister strand crossovers. The ratios of twins to single exchanges, however, give far better fits to the yields expected if these exchanges were in reality radiation induced. Radiation-induced chromatid exchanges can also account for the type of isolabeling observed in the experiments of Peacock without the invocation of a multistranded chromosome. (auth)

29960 POST-RADIATION REDUCTION OF GENETIC DAMAGE IN MATURE DROSOPHILA SPERM BY NITROGEN. F. H. Sobels (Rijksuniversiteit, Leiden). Mutation Res., 1: 472-7(Dec. 15, 1964).

Earlier work showed that post-radiation modification of x-ray damage is strongly influenced by conditions existing at the time of exposure. Thus, when Drosophila males are exposed to x-irradiation under anoxia, and the effect of post-treatment with N_2 is compared to that with O_2, the frequency of recessive lethal mutations is reduced by N_2 in sperm, but by O_2 in spermatids and spermatocytes. After irradiation in O_2, however, post-radiation modification was not observed in either stage of spermatogenesis. These findings were interpreted to mean that repair of premutational damage in sperm is favored by N_2, but in spermatids and spermatocytes by O_2, and that radiation in O_2 restricts the capacity to undergo repair. To verify whether the unexpected finding of post-radiation modification in mature sperm had been caused by shifts in the sampling of sperm cells with different radiosensitivities, the experiments were repeated with pure samples of mature sperm irradiated in the inseminated females. In summary, the results show that after irradiation with 4000 R in anoxia, post-treatment with N_2 consistently reduces the mutation frequency; the same was observed for autosomal translocations. After irradiation with 2000 R in O_2, no post-treatment effect was found for lethals, but the frequency of translocations was significantly reduced by post-treatment with N_2. (auth)

29961 IN SITU AND IN VITRO BREAKAGE OF LAMPBRUSH CHROMOSOMES BY X-RADIATION. O. L. Miller, Jr., Romance F. Carrier, and R. C. von Borstel (Oak Ridge National Lab., Tenn.). Nature, 206: 905-8(May 29, 1965). (ORNL-P-577)

The breakage effects of x radiation on the lampbrush chromosomes of oocytes of the salamander were investigated. Exposure rates between 2,000 and 5,000 R/min were used. The results demonstrated that the immediate breakage (if not all breakage) of chromosomes by x radiation is caused by a direct action of the radiation rather than via an indirect x radiation effect mediated through other cellular structures. The x radiation has an effect on the chromosomes that is morphologically identical to that of DNA. The simplest explanation is that x radiation breaks chromosomes by breaking DNA. (P.C.H.)

29962 EXTRACORPOREAL IRRADIATION OF BLOOD AND LYMPH IN ANIMALS. ITS EFFECT ON HOMOGRAFTS AND ON LYMPHOMA. E. P. Cronkite, A. D. Chanana, and Hp. Schnappauf (Brookhaven National Lab., Upton, N. Y.). New Engl. J. Med., 272: 456-61(Mar. 4, 1965).

Initial results on radioinduced modifications of the homograft response and lymphomatous processes in cattle are presented. Full-thickness pinch grafts were removed from the dorsum of the ear and grafted on the withers in animals experiencing extracorporeal blood and lymph irradiation. Grafts were rejected, but in all cases the rejection process was mild as compared to the violent rejection in animals with a normal complement of lymphocytes. Extracorporeal blood irradiation was beneficial in the treatment of leukemia and lymphomas, but not satisfactory enough for extrapolation to human use. (H.G.D.)

29963 AFFINITY OF EXPERIMENTAL CANCER FOR UNSATURATED FATTY ACID PRODUCED BY X-RAY IRRADIATION. PART I. Takeru Shiaku (Okayama Univ. Medical School, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 916-21(Nov. 25, 1962). (In Japanese)

An unsaturated fatty acid (designated as OX substance) has been previously described as being generated in the liver of x-irradiated rabbits. OX substance is said to exert an anticancer action in humans and animals bearing cancers. The present studies examined the interrelation between OX substance and cancer cells. OX substance was labeled with ^{131}I and injected in doses of 3 mC intravenously in mice implanted with Ehrlich ascites tumor cells (2×10^6) in femoral muscle. Tween 80 was added to the injected ^{131}I-OX solution, prepared in 2% concentration. At various intervals radioactivity was assayed in various organs of these mice. Similar experiments were performed in rats intraperitoneally injected with Yoshida ascites sarcoma cells. Ascites tumor cells were thereafter harvested from peritoneal fluid and homogenized. Radioactivity in various cell fractions was then measured. The results of both experiments were interpreted as showing an affinity of cancer cells for OX substance. Radioactivity persisted longer in mouse Ehrlich tumor cells than in other tissues, and ^{131}I-OX substance was demonstrated in rat Yoshida sarcoma cells 12 hr after injection. In these cells the order of radioactivity decreased from cytoplasmic fluid, mitochondria, microsomes, to nucleus. Possible implications of these findings to the inhibitory action of OX substance on mitosis are discussed. (BBB)

29964 THE INFLUENCE OF GAMMA RADIATION ON THE SUPERSTRUCTURES OF DIVERSE ORGANS—IN PARTICULAR, ON HEPATIC CELLS. Katsuya Nagase. Nippon Igaku Hoshasen Gakkai Zasshi, 22: 1249-57(Mar. 25, 1963). (In French)

Mice were placed in an acrylic resin cage two mm thick, and exposed to 5000 R of ^{60}Co γ radiation in one dose. The 20 mice were sacrificed at one, three, six, nine, or 24 hr after irradiation. The hepatic tissues were removed and prepared for observation under the electron microscope. The one-hr cells had mitochondria and microsomes diffusely distributed in the cytoplasm without noticeable deformation. The γ rays did not deform the microsomes. The three-hr hepatic cells had two types of mitochondria: (1) a convalescent type with visible cristae and an almost normal electron density, and (2) a degenerate type, with or without a membrane, filled with small granules. Hepatic cells observed six hr after γ radiation had irregular and polymorphic mitochondria. There was no change in the nuclear membrane or nucleolus. At nine hr, the mitochondrial membranes and ridges were still visible. The microsomes were more widely separated than in the other cases. There were small, round bodies of weak electronic density

in the cytoplasm. At 24 hr, the mitochondrial membranes were irregular and of high electron density. The mitochondria and microsomes were concentrated near the cell walls, and not around the nuclei. The mitochondria were filled with granules, but lacked any other structures. The nucleus and nucleolus were clearly visible. Gamma rays destroyed the mitochondria within 24 hr after irradiation. (BBB)

29965 A STATISTICAL STUDY ON HUMAN CANCER INDUCED BY MEDICAL IRRADIATION. Shinji Takahashi, et al. (Nagoya Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1510-30(1964).

By direct inquiry it was ascertained whether patients bearing malignant tumors had received irradiation in the past for benign diseases or not. All cancer patients visiting certain hospitals during a definite period were surveyed and their radiation histories investigated. A positive radiation history was specified as irradiation three years or more before the presumed date of onset of the present cancer. The radiation history was examined as regards period of irradiation, age at that time, body part irradiated, name of disease, and number of irradiations received. A control group free of cancer was also included and questioned for items similar to those in the tumor group. Two additional items were also checked, i.e. histories of professional exposure and exposure to the atomic bomb. Two surveys were made, the primary one extending from September 1 to October 31, 1961 which included ambulatory and in-patients of the hospitals selected, while the secondary survey was made from August 15 to October 14, 1962 only for skin cancer and cancer of the neck, including thyroid cancer. In the primary survey conducted in 1961 a total of 21,923 histories were collected. Gastric cancers are the most frequent of malignant tumors in Japan, and the survey of 1961 revealed gastric cancers to be the most numerous. Of the total of 8923 cancers there were 1983 (22.2%) gastric cancers. When the 1983 cases of gastric cancer were classified according to sex and age, and to histories of irradiation, there was no significant difference between the control and irradiated group. A total of 308 cases of skin cancers were examined. Of these 14 (4.55%) had received radiotherapy of the primary cancer site, while in the control group the rate was 6 out of 762 (0.79%), a significant difference at the 1% level. There were 638 cases of thyroid cancer. Of these 29 (4.55%) had histories of therapeutic irradiation with the thyroid within the radiation beam. In the control group of similar age distribution irradiation of the neck was done in 9 out of 1535 or 0.59%, a significant difference at the 1% level. There were 906 cases of cancer of the neck excluding thyroid cancer; namely cancer of the pharynx, larynx, root of tongue, cervical esophagus, parotid, etc. Of these 11 (1.21%) had histories of therapeutic irradiation of the neck; the control group figures were 8 out of 1770, or 0.45%, a difference significant at the 5% level. Thus in these three types of cancer, namely skin, neck, and thyroid cancers, the prior irradiation rate of cancer patients was in all cases higher than of the controls, and the differences were significant. An estimation was made of the tissue dose, and the results for both cancer and control groups classified according to the dose level are tabulated. These results showed that the carcinogenic risk is increased about 5 times after doses of 2000 to 4000 R, and about 10 times after doses of more than 5000 R. An estimation was also made of the relative risk according to length of the latent period. There was seen a tendency for the risk to rise with increasing time after irradiation, with a saturation level tending to occur at about 40 yr. (BBB)

29966 STUDY OF BLOOD CHANGES FOLLOWING THE RADIOTHERAPY BY THE VAN DER WAERDEN METHOD. Nobuo Yamashita and Humihiko Hoshino (Tohoku Univ., Sendai). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1345-7 (Feb. 1964). (In Japanese)

The blood changes due to radiotherapy were observed by the Van der Waerden's statistical method in 50 randomly selected persons. The results are as follows. In erythrocyte count and the hemoglobin quantity, significant differences did not appear between pretreatment and post-treatment groups. For the total leukocyte count a significant difference in time of count was found in men when the level of significance was 5%, and in women when it is 1%. The count after treatment shows a decrease from 12 to 15% of that before treatment. In the lymphocyte count, the significant difference was observed in both sexes when the level of significance was 1%, and the count after treatment showed a decrease of 27 to 31%. In the neutrophylic leucocyte count, the significant difference was not observed in men, but in women, it is observed when the level of significance is 5%. The count decreased by about 15%. Since the Van der Waerden's method applies the standard normal transformation to these ranking samples and examines the significant difference between the two groups, it is simpler than the examination of the significant difference by the t-function in which the hypothesis that two groups are in normal distribution must be examined by the F-function whether or not it is correct. (H.G.D.)

29967 PHOTOINACTIVATION OF TAKA-AMYLASE A. Sam Soon Kim (Kyushu Univ., Fukuoka). Nippon Nogeikagaku Kaishi, 39: 10-17(1965). (In Japanese)

Taka-amylase A is photoinactivated in the presence or in the absence of the sensitizer, riboflavin, by the irradiation of riboflavin band in visible or of amylase band in uv region, respectively. The activity is lost as the result of photooxidation of amylase. The relation between the loss of activity and the amount of oxidized tryptophan residues was obtained by thermal oxidation with N-bromosuccinimide. The activity is completely lost by 100% oxidation of tryptophan residues. From the spectra of photoinactivation in the absence of sensitizer, the fission of cystine residues (-S-S- to -S• •S-) and the tryptophan oxidation are thought to be the main cause of photoinactivation. The relative quantum yields are 99% and 0.8%, respectively. The importance of oxidation of tryptophan residues for inactivation is discussed, together with the fluorescence behavior on photooxidation. (BBB)

29968 FOUR YEARS OF BIOLOGICAL RESEARCH AT FRASCATI. ACTIVITIES OF THE RESEARCH GROUP FOR THE STUDY OF THE EFFECTS OF IONIZING RADIATIONS ON EMBRYONAL DEVELOPMENT (CNEN) FROM NOVEMBER 1958 TO NOVEMBER 1962. Elio Borghese (Universita, Naples). Notiz. Riz. Sci., 4: 549-68(June 1964).

A survey is presented of the activities of this research group, including resumes of 58 studies conducted in radiobiology and related subjects over a 4-yr period. The laboratory equipment and facilities are described and illustrated, and the personnel are listed. The main research projects were as follows: in the field of experimental embryology: differentiation of enterochromaffin cells in chick intestine; development of chick and mouse lung, and (all of the following concerning the mouse) development of pancreas and reproductive apparatus; cleavage of egg; development of limb skeleton; inducing effect of mesenchyme on the branching process of the bronchial tree; reassociation and reorganization of lung anlage after separation into its epithelial and mesenchymal parts; synthesis of DNA in germ cells of testis. In the field of radiobiology: effect of ionizing radiations on mouse spermatogenesis; reaction to irradiation of lung and limb cartilages developing in vitro; differential sensitivity of mesenchyme and epithelium; behavior of mitotic inhibition in organ culture. In addition, mouse caryotype in cells cultured in vitro, as well as the order of magnitude of the lethal dose for the adult mouse of the γ beam of the Frascati Synchrotron were investigated. (BBB)

29969 RADIOACTIVE MATERIALS IN PHARMACY. PART I. INTRODUCTION. P. Spaander (Rijks Instituut voor de Volksgezondheid, Utrecht). Pharm. Weekblad, 98: 958-66(Oct. 11, 1963).

The origins of radioactive samples are discussed. A review of the structure of the atom and proper nomenclature is given, with rules for determining the stability of a given nucleus. The types of natural radioactivity (α particles, β particles, γ rays) and artificial radioactivity are given. Discussed under the latter heading are positrons

(with several examples of this type of decay), ejection of a neutron, internal conversion of an electron, K capture, and metastable states. The mathematics of radioactive decay are outlined, with discussion of half lives and several of the most common examples of radioactive isotopes. Radioactivity is considered as a statistical phenomenon. The most important units in radioactivity are defined: in measurements of quantities of nuclides, the curie and the rutherford; for radiation energy, the electron volt; for radiation, the roentgen. Particular attention is called to the unit of absorbed dose, the rad. (BBB)

29970 RADIOACTIVE MATERIALS IN PHARMACY. PART II. INTRODUCTION. P. Spaander (Rijks Instituut voor de Volksgezondheid, Utrecht). Pharm. Weekblad, 98: 1008-16(Oct. 25, 1963).

The topic of effective biological effects is discussed, and the factor of relative biological effect is introduced to relate this to the absorbed dose. Flux is defined. A further discussion of the term dose is given, with emphasis on the maximum permissible dose. The properties of radiation are discussed, beginning with the general interactions between radiation and matter. Specific properties for α radiation, β radiation, and γ radiation are listed, with a few examples. The range and specific ionizing ability are compared for the first two types. Ionization by γ rays is considered in the categories of the Compton process, the photoelectric effect, and pair production. A short note on the interactions of neutrons with matter is given. Protection from the three types of radiation is discussed with a few examples of necessary barriers. Calculation of protection from γ radiation is demonstrated and proper terms are defined. Practical examples are illustrated with specific importance attached to calculation of the halving thickness. (BBB)

29971 HISTOCHEMICAL INVESTIGATIONS OF CERTAIN ENZYMES IN THE PULMONARY TISSUE IN VARIOUS PERIODS OF ACUTE POST-IRRADIATION DISEASE. Stanislaw Kosmider, Jan Jonek, and Stanislaw Gajos. Polski Przeglad Radiol. i Med. Nuklearnej, 29: 215-26 (Mar.-Apr. 1965). (In Polish)

Histochemical investigations were performed upon the localization and activity of DPNH-diaferrase, succiniledehydrogenase, ATP-ase acid, and alkaline phosphatases, thioloacetic esterase, and E-600 resistant esterase. The material for investigations was collected from the lungs of irradiated guinea pigs in various phases of post-irradiation disease. The results demonstrate a decrease of respiratory enzymes activity after irradiation, which may cause a decrease of cellular oxidation. Along with the development of radiation disease, the reaction, for detection of ATPase and alkaline phosphatase in the small blood vessels walls, decreases. It may be assumed, that this phenomenon is accompanied by a deterioration of active substrate transportation processes from the blood to the cytoplasm. An increase of acid phosphatase activity in the lungs of irradiated specimens may be due to an increase of number of phagocytes in the pulmonary tissue. The decrease of nonspecific esterases activity may be caused by disturbances in fat metabolism, while the increase of the E-600 resistant esterase activity may be due to augmented proteolytic processes. It may be assumed, that irradiation leads to various metabolic disturbances in the pulmonary tissue. (tr-auth)

29972 HISTOCHEMICAL STUDIES ON THE ACTION OF ULTRASOUND AND X IRRADIATION ON EHRLICH ASCITES TUMOR OF MICE. M. Paal, J. Koever, S. S. Coemor, and R. Hunka (Univ. Medical School, Budapest). Rehabilitation (Bonn), 16: 129-32(Dec. 1963). (In German)

Four groups of female mice were injected with Ehrlich ascites tumor cells and subsequently treated as follows: Group 1 remaining as controls; Group 2 was submitted to three min of ultrasound (1.5 w/cm^2, 850 kc); Group 3 received this ultrasound treatment plus a daily local (2 × 3 cm) abdominal irradiation of 180-kv x rays (fractions of 400 R daily to total doses of 2000 R); and Group 4 mice were submitted to both ultrasound and ionizing irradiation in the above doses and schedules. Six to 7 days after injection, the tumors became visible. One day after the last treatment, ascites tumor cells were studied by histochemical methods. Compared with control cells, those of Group 2 showed paler staining reactions for DNA and RNA, while lipid staining (with Sudan black) was increased in intensity. Carbohydrate (stained with periodic acid-Schiff reaction) was unaltered. Cells of Group 3 animals generally showed even less nucleic acid staining intensity, especially RNA, and lipid was accumulated in droplets under the nuclear membrane. Cellular changes were generally less marked in Group 4 than Group 3, showing that ultrasound plus ionizing radiation caused most intensive changes in the tumor cells. The observed lipid accumulation and vacuolation of irradiated cancer cells confirms the results of previous studies. Possible clinical use of these two modalities in cancer therapy is mentioned. (BBB)

29973 VARIATIONS IN PHAGE GROWTH AFTER TREATMENT OF THE HOST BACTERIUM (ESCHERICHIA COLI) WITH TRITIATED WATER. F. Mauro, G. Giovannozzi-Sermanni, and M. Botre (Universita, Rome). Ric Sci., Rend., Sez. B., 3: 403-12(Dec. 1963). (In Italian)

The effect of THO on the system lambda (λ) phage-E. coli C 600 was investigated to elucidate the kinetics of phage development in this medium. The THO used had a specific activity of 1.6 mC/ml, and its final concentration in the culture medium was 0.8 mC/ml, giving a dose of about 10 rad/hr. In some tests, mercaptoethyl amine (MEA) was added as a radioprotective agent at 10^{-4} to 10^{-2}M. THO did not affect bacterial growth as measured turbidemetrically. However, in the presence of THO, phage multiplication was accelerated as seen by a doubling of the decrease in turbidity of cultures (23.6 relative units) compared with cultures containing H_2O (12.6 units). MEA influenced phage multiplication as seen by the near normal decrease of turbidity in the presence of 10^{-2}M MEA (18.0 units) and 10^{-4}M MEA (17.0 units). Irradiation from THO increased the burst size on agar cultures from 226 units in nonirradiated cultures to 864 units in cultures receiving 164 rad and 2440 units in those receiving 327 rad. Thus the higher dose augmented burst size 10 fold. This increase in burst size reflects an increase in rate of phage growth. The enhancement of phage growth as seen by both the more rapid drop in turbidity in THO-containing cultures and the enlarged plaque size, at the low doses of radiation involved, did not appear to be related to the reproductive capactiy of the bacterial host which did not appear to be influenced by THO under the conditions employed. (BBB)

29974 FUNDAMENTALS OF RADIOBIOLOGY. Wolfgang Laskowski (Freie Universitat, Berlin). Roentgen-Lab. Praxis, 17: 247-60(Nov. 1964). (In German)

The primary physical and chemical reactions produced in biological material by absorption of radiant energy are known relatively well, and form the starting points for the processes that lead to biological manifestations. Considerations that are relevant for the biological effects produced by irradiation are related to kinetics, genetics, and biochemistry. They indicate overwhelmingly that irradiation energy units do not interact directly or irreversibly with critical cell constituents of biological substances. The production of irreversible irradiation effects in critical cell components depends on the physiological conditions that may prevail in the organism at the time of irradiation and immediately afterward. Germinal material is a critical cell component whose functions can be altered extensively and significantly by a relatively small amount of irradiation energy units. Germinal material has been chemically identified as deoxyribonucleic acids. Irradiation effects on their structure and function are now studied in great detail. (BBB)

29975 ON THE EFFECT OF RADIOACTIVELY IRRADIATED PANTOTHENIC ACID ON THE BLOOD. 1. THE EFFECT OF RADIOACTIVE RADIATIONS ON PANTOTHENIC ACID. W. A. Ritschel. Sci. Pharm., 29: 250-7 (1961). (In German)

Pantothenol and Na pantothenate solutions were irradiated with α particles from Rn gas or β particles from ^{106}Ru. As measured in vitro against Lactobacillus arabinosus, various

combinations of irradiation times and doses altered the biochemical activity differently. After 351 hr irradiation with Rn, with total doses of 3, 8, and 30 R, Na pantothenate activity was reduced by 1, 23, and 26%, respectively. After 30 R, pantothenol activity was reduced by 76%. After 70 and 159 hr, with total doses of 12 and 21 R, pantothenate activity decreased 12 and 24%, respectively. When cysteine was added to solutions prior to α irradiation for 351 hr, with a total dose of ~30 R, pantothenate activity was reduced by 14% and pantothenol activity by 25%. With reductose added instead of cysteine, the decreases were 25 and 90%. After β irradiation for 112, 165, and 356 hr, with doses of 225, 330, and 700 R, pantothenate activity decreased by 23, 28, and 31.5%. After 700 R pantothenol activity decreased by 70%. With prior cysteine addition, pantothenate activity decreased 11.5%, and pantothenol activity decreased by 76%. When the solutions were irradiated with reductose present, results were similar. The results indicated that cysteine and reductose protected against β irradiation in pantothenate solutions, but only cysteine was effective against α irradiation. Pantothenol was not protected by either of these additives. (BBB)

29976 ON THE EFFECT OF RADIOACTIVELY IRRADIATED PANTOTHENIC ACID OF THE BLOOD. 2. PANTOTHENIC ACID DETERMINATION IN SERUM, BLOOD COAGULATION, AND ESTIMATION OF THROMBOPLASTIN TIME. W. A. Ritschel. Sci. Pharm., 30: 73-86(1962). (In German)

After single administration of pantothenol or Na pantothenate that had been previously irradiated with α or β radiation to rabbits, the serum concentrations of pantothenate were about twice as great as in animals that received unirradiated pantothenate. This was increased to about a factor of three times normal after daily administration for 7 days. Blood coagulation time was reduced about 25% in animals that received unirradiated pantothenate, but it was reduced about 50% in animals that received a single administration of irradiated pantothenate. More frequent administration did not reduce blood coagulation time any more than this. Thromboplastin time was also reduced after unirradiated pantothenate was given to the animals. This reduction was about 20%. However, after β-irradiated pantothenate was given, the reduction observed was about 40%, and it was about 100% after α irradiated pantothenate had been given. A single administration of irradiated pantothenate reduced thromboplastin time almost as much as when it was given daily for 7 days. (BBB)

29977 ON THE EFFECT OF RADIOACTIVELY IRRADIATED PANTOTHENIC ACID ON THE BLOOD. PART 3. COMPLEMENT ESTIMATION AND DISCUSSION OF THE RESULTS. W. A. Ritschel. Sci. Pharm., 31: 221-30(1963). (In German)

An increased complement formation was shown when pantothenol or Na pantothenate previously irradiated with α or β radiation was added to rabbit serum. The increase amounted to from 22 to 85%, with the β-irradiated substances producing the greatest effects. Also, the pantothenate salt effect was almost twice as great as the effect from pantothenol. The α-irradiated pantothenol increased complement formation by more than 22%, while the α-irradiated pantothenate increased it by more than 50%. Pantothenol that had been β irradiated increased complement formation by about 50%, but the β-irradiated pantothenate increased it by more than 85%. Previous studies have indicated that unirradiated pantothenate increases antibody formation. In view of this, the increased complement formation caused by irradiated pantothenate suggests that it could be used in place of unirradiated pantothenate to increase antibody formation markedly. This would be a distinct advantage in combating infection. (BBB)

29978 STUDIES OF THE INCREASE IN ANTIBODY FORMATION WITH PARENTERAL POLIOMYELITIS VACCINATION. W. A. Ritschel and G. Ritschel-Beurlin. Sci. Pharm., 31: 230-41(1963). (In German)

Effects of unirradiated Na pantothenate were compared with those of α- or β-irradiated pantothenate as to their effects on antibody formation against polio vaccine. Polio vaccine alone increased complement formation by 35%. Polio vaccine administered with unirradiated pantothenate increased complement formation by 50%. When given with pantothenate that had been α irradiated with 30 R, or with pantothenate previously exposed to 700 R of β irradiation, complement formation was 70 and 77%, respectively. There was also an increase in the precipitin reaction in the irradiated pantothenate groups, as compared to the unirradiated pantothenate. On the basis of these results, injection of pantothenate irradiated with about 700 R of β irradiation, simultaneously with polio vaccine, produced a significant increase in antibody formation. 79 references. (BBB)

29979 IMMUNOLOGIC TOLERANCE IN THYMECTOMIZED, IRRADIATED RATS GRAFTED WITH THYMUS FROM TOLERANT DONORS. Katarina Isakovic, Stanley B. Smith, and Byron H. Waksman (Belgrade Univ. and Yale Univ., New Haven). Science, 148: 1333-5(June 4, 1965).

Lewis rats, thymectomized at 5 weeks of age and irradiated at 8 weeks, received grafts of adult thymus and marrow, one or both grafts being derived from donors tolerant to bovine γ-globulin. Challenge 3 or 6 weeks after grafting showed that delayed sensitization could not be induced in animals that received a tolerant thymus or tolerant thymus and marrow, though sensitization to a heterologous antigen (chicken ovalbumin) occurred normally. Arthus reactivity was regained slowly in animals receiving normal thymus and marrow and, to an equal extent, in those receiving grafts from tolerant donors. (auth)

29980 SKIN GRAFTS: DELAYED REJECTION BETWEEN PAIRS OF CATTLE TWINS SHOWING ERYTHROCYTE CHIMERISM. W. H. Stone (Univ. of Wisconsin, Madison), R. G. Cragle, E. W. Swanson, and D. G. Brown. Science, 148: 1335-6(June 4, 1965).

Although dizygotic cattle twins with erythrocyte chimerism exhibit complete tolerance to each other's hematopoietic tissues exchanged in utero by way of chorionic anastomoses, they may not be completely tolerant to each other's histocompatibility antigens. Skin grafts exchanged between partners of 21 pairs of chimeric twins were rejected by more than half of the twins in an average of 250 days. (auth)

29981 QUALITATIVE AND QUANTITATIVE STUDIES OF THE COURSE OF ANTIBODY PRODUCTION. II. ANALYTICAL OBSERVATION OF ANTIBODY PRODUCTION IN IRRADIATED ANIMALS. Iwao Okano (Tokyo Univ.). Tokyo Igaku Zasshi, 67: 1522-34(Dec. 1959). (In Japanese)

The influence of whole-body x irradiation on antibody formation against human whole serum in the rabbit was studied. Antibody titer fluctuation of human normal antibodies (i.e. isoagglutinins of the ABO system) was also studied in humans irradiated for various therapeutic purposes. The first appearance of antibody in the serum was definitely delayed in rabbits exposed to x rays (500 to 1000 R) over the whole body. After immunization with human whole serum, the first appearance of antibody in the nonirradiated rabbits was demonstrated within one week after the first injection, whereas only after 15 to 20 days in the irradiated rabbits. The order of appearance of antibodies against the serum fractions in the irradiated rabbits was in general the same as in the nonirradiated, i.e. antibodies seen first were against α- and β-globulins, then γ-globulin, followed by albumin. Complement fixation was depressed with antiserums from the irradiated animals. Normal anti-A and anti-B antibodies titers were decreased in about 60% of the patients irradiated with x rays or ^{60}Co γ rays. (BBB)

29982 EFFECT OF THYMECTOMY, SPLENECTOMY, AND IRRADIATION ON MOUSE SKIN HOMOTRANSPLANTATION. Louise Leonard and Gisela McHutchison (Veterans Administration Hospital, Albuquerque, N. Mex.). Transplantation, 3: 343-9(May 1965).

Data are presented that: demonstrate that high tolerance to BALB/c skin grafts can be induced in thymectomized, cobalt irradiated (450R) DBA/2 mice; and indicate that this tolerance is enhanced in older DBA/2 recipients with re-

moval of the spleen. In contrast, data are presented that: demonstrate that a significantly high tolerance to BALB/c skin grafts can be induced in thymectomized, cobalt-irradiated A strain mice only after an increase in the irradiation dosage from 450 to 550 R; and suggest that this tolerance may be enhanced in older mice with removal of the spleen. The results suggest that both increased irradiation dosage and genetic relationship of graft and recipient were the key factors in prolonged acceptance of the grafts. (auth)

29983 EFFECT OF THYMUS GRAFTS, SPLEEN CELL INJECTION, AND SUBLETHAL IRRADIATION ON HOMOGRAFT TOLERANCE IN MICE. Bertie F. Argyris (Syracuse Univ., N. Y.). Transplantation, 3: 350-5(May 1965).

Homograft tolerance to CBA skin grafts can be abrogated by a variety of treatments administered to young tolerant C3H mice. Effective treatments consist of s.c. transplantation of thymus grafts, with or without diffusion chambers, and s.c. injection of viable CBA spleen cells in the vicinity of the homograft. The significance of these findings is discussed in relation to the maintenance of homograft tolerance. (auth)

29984 THE CAPACITY FOR SKIN REJECTION IN MICE THYMECTOMIZED NEONATALLY OR IN ADULT LIFE. J. F. Goedbloed and O. Vos (TNO, Rijswijk, Netherlands). Transplantation, 3: 368-79(May 1965).

The effects on the capacity for rejection of allogeneic and xenogeneic skin grafts by: neonatal thymectomy; thymectomy in adult mice followed by sublethal irradiation; and thymectomy in adult mice followed by lethal irradiation and syngeneic bone marrow transplantation, were investigated. The first and third procedures caused the greatest impairment of immunological reactivity. Skin grafts from mouse strains differing at the H-2 locus and from rats were tolerated for longer than 50 days by many animals. In two mice even rabbit grafts were tolerated more than 50 days. The greatest impairment of the capacity of foreign skin rejection in adult mice was obtained if small numbers of bone marrow cells (0.2×10^6) were transplanted. The capacity for skin rejection was restored if large numbers of bone marrow cells were grafted or if lymph node or thymus cells were added to the bone marrow. In this respect lymph node cells were more effective than thymus cells, which in turn were more effective than bone marrow cells. The treatment that caused the greatest impairment of the host's capacity for foreign skin rejection also caused the greatest incidence of wasting and a reduction of the number of lymphocytes in the peripheral blood. Wasting and blood lymphocyte depletion were closely correlated. Comparison of individual mice within the same group revealed a less pronounced correlation between wasting and unresponsiveness to foreign skin grafts. (auth)

29985 LIMITED DURATION OF IMMUNOLOGICAL TOLERANCE AFTER CELL TRANSFER. D. W. van Bekkum, L. E. J. Holt-Moor, and H. Balner (TNO, Rijswijk, Netherlands). Transplantation, 3: 448-51(May 1965).

Groups of irradiated CBA/Rij mice were injected with hemopoietic and lymphatic cells from CBA/Rij → (CBA/Rij × C57BL/Rij)F_1 chimeras. Six or 12 weeks later C57BL skin was grafted. A number of animals retained the graft for more than a month. In other groups of mice signs of weak homograft reactivity were observed in the skin grafts and both graft versus host (GvH) tests showed a significantly positive reaction in (CBA × C57BL)F_1 newborns. These results indicate that even in the CBA parent → hybrid → parent transfer series the majority of the animals had lost acquired immunological tolerance after about 100 days. Also, sensitivity of the GvH assay was found to be at least equal to the sensitivity of microscopical examination of skin grafts. (P.C.H.)

29986 HOST-CELL REACTIVATION OF LETHAL DAMAGE INDUCED BY ULTRAVIOLET LIGHT AND X-RAYS IN SERRATIA MARCESCENS HY AND ITS PHAGE KAPPA. Ulrich Winkler (Goethe Universitat, Frankfurt am Main). Virology, 24: 518-20(Nov. 1964).

Properties of HCR (host-cell reactivating) mutants of Serratia marcescens and the temperate phage kappa are described that show similarities to corresponding E. coli mutants. (H.G.D.)

29987 THE ENDANGERMENT OF THE HUMAN EMBRYO DURING THE FIRST WEEKS OF PREGNANCY. G. Toendury (Universitat, Zurich). Wien. Klin. Wochschr., 75: 869-72(Dec. 6, 1963). (In German)

Depending on the developmental stage of the embryo, damage caused by x irradiation of the neural tube and other regions can be demonstrated easily in mice by exposure to from 40 to 1000 R. Similar sensitivity to x irradiation is demonstrable in human fetuses. In one group of 75 children, of whom 38 were abnormal, 28 cases could be related back to prior pelvic irradiation of the mothers. Of the abnormal infants there were 16 microcephalic idiots. Irradiation of the pelvic region should be restricted to the preovulation stage, or to the first 14 days after the last menstruation. In pregnant women it should be completely avoided. The period of pregnancy when the embryo is most sensitive to irradiation is between the 15th and 42nd day. Also, as a result of the extended development of the two cerebral hemispheres in humans, these may remain susceptible to radiation injury even up to the time of birth. Even though for most of pregnancy the embryo is not as sensitive as it is from the 15th to the 42nd day, this should be taken to indicate that larger doses of irradiation are still as effective in causing injury as smaller ones are during the more radiosensitive period. (BBB)

29988 ON NUCLEAR-INDUCED PLASMA AND PLASTID MODIFICATIONS. P. Michaelis (Max-Planck-Institut fur Zuchtungsforschung, Cologne). Z. Naturforsch., 20b: 264-7(Mar. 1965). (In German)

In preliminary compact form, a nuclear mutation occurring after isotope (^{32}P) treatment is reported. This mutation then induces numerous very different plasmic and cytoplasmic modifications. In the problem of plastid mutation it is of interest that under the altered plastids secondary plastid modifications (colorless to green, pale green to colorless) can occur. (tr-auth)

29989 RADIATION HAZARDS. H. Zaadnoordijk. Ziekenhuiswezen, 36: 372(Oct. 1963). (In Dutch)

Radiation produces damage by direct and indirect pathways, considering both electromagnetic and corpuscular radiation. After defining units (R, rad, rem), the danger in direct irradiation of the body is considered. Various aspects of specific cell damage are mentioned, and comparison of single doses and short doses over prolonged periods of time is made. The susceptibility of the young and of the embryo to radiation damage is emphasized, and the delayed results of excessive radiation doses are enumerated. Genetic damage is then discussed. The extent of natural radiation is given, together with the danger of fallout. The control measures of the government of the Netherlands allow 0.1 rad/week as the maximum permissible dose; for neutrons this is even smaller. Suggestions for control of radiation dangers in a hospital are given: special laboratories, x-ray sections, shielding materials, special care with Ra, wearing of film badges, maintenance of cleanliness of laboratories and care of personnel, restriction of studies to certain classes of danger, and formation of interdisciplinary groups to handle problems in the larger hospitals. The last would include a physician, physicist, and radiochemist. (BBB)

29990 THE EFFECTS OF 200 kv X RAYS AND ^{60}Co GAMMA RAYS ON YEAST CELLS AND THE RBE OF ^{60}Co. W. Weder. Thesis, Muenster, Ger., Universitat, 1964. 70p. (In German). $2.00 (Gmelin, AED-DISS. 64-464).

The value of the relative biological effectiveness (RBE) for yeast cell inactivation by ^{60}Co gamma rays was found to be 0.8. This result is compared with data from the literature on the RBE of x radiation. (95 references.) (Gmelin Inst.)

29991 RADIATION DAMAGE AND DELAYED EFFECTS OF BECHTEREW PATIENTS TREATED WITH PETEOSTHOR AND Th X 5-10 YEARS AGO. H. Gruetzediek. Thesis, Kiel, Universitat, 1964. 86p. (In German). $2.00 (Gmelin, AED-DISS. 64-467).

Fifty-nine patients treated with Th X 5 to 10 years ago were assessed for delayed radiation effects. Nine patients had died but no relation between death and Th X treatment was apparent. (Gmelin Inst.)

29992 RESPIRATION AND PHOTOSYNTHESIS OF CHLORELLA DURING GAMMA IRRADIATION. F. Koessler. Thesis, Berlin, Humboldt-Universitat, 1964. 76p. (In German). $2.00 (Gmelin, AED-DISS. 64-472).

Continuous low dose rate irradiation results after 5 to 6 days (5000 R total dose) in a respirational depression down to 50% of the initial value. The remaining respiration is not changed by further irradiation. Decreased respiration can be increased by ultraviolet irradiation. Intensity of photosynthesis is unchanged up to 100 kR. (Gmelin Inst.)

Radiation Effects Therapy and Countermeasures

Refer also to abstract 30173.

29993 (AD-609220) POTENTIAL ANTIRADIATION DRUGS. Annual and Final Report, July 1, 1963–June 30, 1964. Peter T. Kan and John D. Behun (Wyandotte Chemicals Corp., Mich.). July 15, 1964. Contract DA-49-193-MD-2469. 63p. $3.00(CFSTI).

N-substituted fluoroalkyl derivatives of 2-mercaptoethylamines were synthesized to serve as potential antiradiation drugs. These compounds were prepared from the thioethylation of fluoroalkylamines with ethylene sulfide. Variations in the structures of fluoroalkylamines were achieved by the development of synthetic routes towards simple fluoroalkylamines as well as fluoroalkyl-substituted aminoalcohols. A number of unsuccessful approaches towards the synthesis of 1- (and 2-)perfluoroalkyl-2-mercaptoethylamines were investigated. (auth)

29994 (ANL-6971(p.206-14)) RADIOPROTECTION. (Argonne National Lab., Ill.).

Data are presented from an investigation of the components of unirradiated protoplasm that have the capacity to prevent death in single cells that have been exposed to supralethal doses of ionizing or ultraviolet radiation and the components of living amoebae, essential to life, that are damaged by radiation. Unirradiated protoplasm was used as a therapeutic agent in studies on Pelomyxa illinoisensis, Pelomyxa carolinensis, and Amoeba proteus. Brief tabulations are included on the effects of various growth media, the effects of antibiotics on radiosensitivity, and the effects of various metabolic inhibitors and chemical compounds on restoration after lethal radiation exposure of amoebae treated with donor protoplasm. Therapeutic methods for use in poisoning by radioactive and nonradioactive metals are discussed. The use of chelating agents, such as diethylenetriaminepentaacetic acid, and the manipulation of normal physiological processes to accelerate excretion of the toxic metal are discussed. Results are reported from studies in mice with Pu poisoning treated by both methods and the evaluation of a new organic chelating agent, desferrioxamine B-sulfonate (DFOM), for effects on urinary excretion of Pu by mice. (C.H.)

29995 (TID-21871) SYNGENEIC HAEMATOPOIETIC THERAPY IN MICE. A. M. Cross (Chester Beatty Research Inst., London (England)). 1965. Contracts [AT (30-1)-2702] and 103/US. 105p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

Progress is reported in studies of the hematological effects of doses of 300, 500, 700, and 850 R x radiation in mice and the protection against radiation injuries afforded by the injection of cells from various hematopoietic tissues. Data are included on the protective effects of various numbers of cells from bone marrow, spleen, or fetal liver. The weight of the spleen, thymus, and lymph nodes, number of cells in femur bone marrow, and histological studies were used to determine radiation injury and recovery at various time intervals. The correlation between peripheral blood and hematopoietic organ changes and the effect of thymectomy on radiation injury and immune response of adult and neonatal mice were also studied. (33 references). (C.H.)

29996 CHEMICAL PRE-PROTECTION AGAINST IONIZING RADIATION. Stanley H. Kramer. Armed Forces Chem. J., 19: No. 3, 3-7(Sept. 1964).

Three theories (anoxia, free radical, and mixed disulfide) concerning the mechanisms of radioprotectors are discussed. Based on studies with dogs, sulfhydryl compounds offer promise as radioprotectors, although toxic side effects must be eliminated before human use is possible. (H.G.D.)

29997 CHEMICAL PROTECTION AGAINST IONIZING RADIATION. W. de Loecker (Universitet Leuven, Louvain, Belg.). Belg. Tijdschr. Geneesk., 19: 1169-81(Nov. 1, 1963). (In Dutch)

Primary processes in chemical compounds subjected to irradiation stem from the formation of free radicals. These may then abstract hydrogen to form new radicals, may form cross links, or may abstract H from a hydrogen donor. Most damage in macromolecules comes from the formation of cross links, so that compounds chosen as radiation protectors must suppress this process. Hydrogen donors are considered, particularly those containing a sulfhydryl group: cysteine, cysteamine, thioglycol, thioglycollic acid, dithiocarbaminate, β-mercaptoethylguanidine, homocysteine, BAL-sulfonic acid Na salt, AET, BAL, 2-aminothiazoline, 5-mercaptopyridoxine, and 5-mercaptomethylpyridine are discussed among others. Amines are also reviewed: 2-iminotetrahydro-1,3-thiazine, epinephrine, 2,4-dioxo(5,6-benz)-2,3-dihydro-1,3-oxazine, histamine, 3-amino-1,2,4-trizole, nicotinamide, tryptamine, serotonin, and noradrenaline are discussed, together with chemical effects and biological effects of inhibitors and accelerators of serotonin formation. The mechanism of chemical radiation protection is discussed; this review mentions the effects of chemical inhibitors of S protection as well. (BBB)

29998 CHEMICAL COMPOUNDS FOR RADIATION PROTECTION. O. Suzuki. Genshiryoku Kogyo, 9: No. 8, 41-5(1963). (In Japanese)

The factors causing radiation damage and the principles of chemical protection are discussed briefly. Studies in this field have clarified the mechanism of radiation damage, but no really practical protective substances have been found. The protective effect of chemicals may be exerted in three ways: combination with the free radicals to protect the basic cell molecules; combination with the cell molecules to form a substance that inhibits the free radical action; or decrease of the HO_2 content. Chemicals suitable for practical use may be: cyanides, e.g. KCN, NaCN; cysteine and glutathione; cysteamine and AET; other sulfides, e.g. dimercaptopropanol; internal complex preparations, e.g. diethyldithiocarbamate; hydroxyl compounds, e.g. alcohols, saccharides; carboxy acids, e.g. formic, caprylic; amino acids (other amino acids are less effective than the above-mentioned sulfur-containing ones); amines, e.g. 5-hydroxycryptamine; and simpler compounds, the majority of which are –SH compounds. (P.C.H.)

29999 STRONTIUM EXTRACTION FROM AN ORGANISM. I. Odava. Genshiryoku Kogyo, No. 11, 41-5(1963). (In Japanese)

Chemicals for removing radioactive strontium from the skeleton were studied with male white mice that had been injected subcutaneously with $^{90}Sr + {}^{89}Sr$. Sodium-potassium, sodium-magnesium, and sodium-strontium citrates, potassium-magnesium amino-oxypropionate, particularly in the presence of ammonium chloride; magnesium sulfate and thiosulfate; and the hormones hydroxycortisone, prednisolone, and thyroxine removed radioactive strontium. Sodium triphosphopyridine glucoside, cocarboxylase, and ammonium chloride increased urinary excretion of radiostrontium but did not decrease that in the bones. Ethylenediaminetetraacetic acid, diethyltriamine-pentaacetate, 2,2-bis[di(carboxymethyl)amino]diethyl ether, sodium adenosine triphosphate, sodium and sodium-lead citrates,

strontium chloride and gluconate, the diuretics that remove calcium, and metabolism depressant were not effective. Salts that can cause sodium poisoning, deoxycortisone, and thyroid depressant inhibited radiostrontium removal. Simultaneous use of sodium thiosulfate with magnesium, calcium, or strontium (thiosulfates) increased their effect. Sodium fluoride increased bone deposition. (IIC-M.G.)

30000 RADIOSENSITIZATION BY COPPER IONS, AND CONSEQUENT REVERSAL OF THE OXYGEN EFFECT. W. A. Cramp (Hammersmith Hospital, London). Nature, 206: 636-7(May 8, 1965).

The effects of added cupric salts on bacteria were investigated. Cupric chloride was added to saline ($0.067 \times \underline{M}$) suspensions of Shigella flexneri about 5-10 min before irradiation. The suspensions were irradiated with an electron beam (8 Mev) at a dose rate of about 20 kRads/min, under anoxia and aeration for each concentration of copper salt used. No sensitizing action was observed when the irradiated suspensions were aerobic, whereas in the absence of oxygen there was marked sensitization, the extent of which depended on the copper concentration. At concentrations of 4×10^{-6} M copper, and above, the anoxic bacterial suspensions were more sensitive than both the aerated control suspension and the aerated suspensions containing the same concentration of copper. (P.C.H.)

30001 SPACE MEDICINE: SCOPE, PROGRESS, AND APPLICABILITY TO OTHER MEDICAL FIELDS. S. P. Vinograd (National Aeronautics and Space Administration Headquarters, Washington, D. C.). Postgrad. Med., 36: 95-101(Aug. 1964).

The hazards of extraterrestrial radiation in space exploration are reviewed, and the use of radioprotective drugs (including cystamine, amygdalin, serotonin, stilbesterol, and vitamins B, C, and P) is discussed. (BBB)

30002 THE PREVENTION OF RADIOTHERAPY COMPLICATIONS BY A PYRIDINE DERIVATIVE. J. Herail. Progr. Med. (Paris), 91: 17-19(Jan. 10, 1963). (In French)

The active fraction of the drug tested, 53-11 C (Euclidan), consists of nicotinic acid (arteriole vasodilator) and diethylaminoethanol (inhibitor of vasoconstrictor reflexes and cardio-moderator). A daily dose of 50 mg 53-11 C was administered to two groups of patients suffering from effects of irradiation and/or cancer. Thirty-one patients who had received 4000 to 7000 R/tumor ^{60}Co therapy over 30 to 50 days showed asthenia, and loss of weight. They were treated with 53-11 C for two periods of 10 days each. In eight cases there was an improvement in the general state of health, and particularly in the asthenia after treatment. Some of the patients gained weight and the blood count improved. In 13 other patients, the physiotherapy treatment was ended with the patients in satisfactory condition. In nine other cases, the side-effects of radiation treatment could not be avoided, but the treatment had to be interrupted in only two cases. One other patient died in the course of treatment. The tolerance to radiotherapy seemed to be increased by 53-11 C. Patients given 53-11 C treatment before cancer surgery generally showed a decrease in anxiety and a better tolerance of surgery. In four of nine cases treated postoperatively, there was an improvement in the general condition, and in none of them was the healing delayed. (BBB)

30003 CONTRIBUTION TO THE STUDY OF THE RADIOPROTECTIVE PROPERTIES OF 2-MERCAPTOBENZOTHIAZOLE. M. C. Lopez Zumel, Y. Bernard, and R. Rinaldi (Instituto de Quimica-Fisica Rocasolano, Consejo Superior Investigaciones Cientificas, Madrid). Rev. Espan. Fisiol., 20: 121-8(Sept. 1964). (In Spanish)

The toxicity, tissue distribution, and radioprotective action of 2-mercaptobenzothiazole (MBT) were studied in mice of the C3H/Jax strain, 12 to 18 weeks of age. Injection of MBT intraperitoneally in mice resulted in convulsions a few minutes after injection, and at high doses of MBT, death of the animals. The $LD_{50/30}$ for MBT after a single injected dose was 0.75 mg/g body wt. For radioprotection experiments the mice received whole-body x radiation (180-kv) at a rate of 80 R/min to total single doses of 650, 700, 750, 850, and 950 R. The 30-day mortality rates of mice receiving an intraperitoneal injection of 0.38 mg/g (in olive oil) 30 min before irradiation were 70, 35, 32, 20, and 0% for these respective doses. In contrast, 100% of unprotected irradiated controls had died by the 12th day after all doses. MBT markedly lowered the body temperature (to 31°C 50 min after injection) and it remained low for several hours. To study its distribution, sections of whole mice were examined by autoradiography after injection of 100 μC of ^{35}S-labeled MBT. High levels of ^{35}S-MBT were found in kidney, and it was rapidly excreted and eliminated from the body (totally 6 hr after injection). In vitro protective action was noted when MBT was added to solutions of bilirubin. Changes in the absorption spectrum of the pigment (3500 to 5000 Å) were markedly less when it was irradiated in the presence of MBT. (BBB)

30004 THE USE OF HYDROGEN PEROXIDE AS A SOURCE OF OXYGEN IN A REGIONAL INTRA-ARTERIAL INFUSION SYSTEM. J. T. Mallams, J. W. Finney, and G. A. Balla (Baylor Univ., Dallas). Southern Med. J., 55: 230-2(May 1962).

Experiments were conducted in dogs and rats to investigate the enhancement of tumor cell radiosensitivity by H_2O_2. Doses of H_2O_2 in 5% dextrose in water capable of delivering from 10 to 200 ml of oxygen were pumped into the femoral artery of anesthetized dogs. A rise in venous oxygen was uniformly noted during the course of and immediately following the infusion. No ill effects were noted. To determine the influence of oxygen presented in the foregoing manner upon the radiosensitivity of Walker 256 rat carcinosarcoma, male Wistar rats received implants of 10^5 to 10^6 cells in each hind leg. The lesion in the left leg was exposed to a 1250-R dose of 250-kvp x irradiation, and the equivalent of 1.0 to 2.0 ml of oxygen was infused. The lesion in the right leg was then immediately exposed in the same manner and dose of x irradiation as the left leg lesion. Control groups received either irradiation only or H_2O_2 only. In the control groups the tumors showed no change, while in the experimental groups the lesions in the right leg showed marked gross and histologic changes within the first 48-hour period after irradiation. No change was noted in the lesion in the left leg during the time period of observation. In a preliminary clinical evaluation, four patients were studied. Three had carcinoma of the head and neck; one patient had a glioblastoma multiform involving both cerebral hemispheres. The three patients with head and neck tumors were infused through the external carotid artery with doses equivalent to 100 to 200 ml of oxygen. The patient with the glioblastoma was infused into both internal carotid arteries. None of the patients showed adverse clinical effects, and the early evidence suggests an increased therapeutic ratio in malignant tumors to ionizing irradiation. (BBB)

30005 PROTIVOLUCHEVYE SREDSTVA SPRAVOCHNIK. (Handbook of Radioprotective Chemicals). L. A. Tiunov, G. A. Vasil'ev, and E. A. Val'dshtein. Moscow-Leningrad, Izdatel'stvo "Nauka," 1964. 320p.

The handbook contains data on radioprotective and prophylactic properties of one thousand chemical preparations. The structures and synonyms of preparations published in the handbook of 1961 are not included. 827 references. (R.V.J.)

Radiation Hazards and Protection

See *also* HEALTH AND SAFETY.

Refer also to abstracts 30909 and 31443.

30006 (CEA-Bib-53) CONTAMINATION DIRECTE DES VEGETAUX ET IRRIGATION PAR ASPERSION: ETUDE BIBLIOGRAPHIQUE. (Direct Contamination of Plants and Irrigation by Spraying. Literature Survey up to April 1st, 1964). Bittel, Robert; Clement, Jean-Louis (Commissariat à l'Énergie Atomique, Saclay (France). Centre d'Études Nucléaires). Apr. 1965. 83p. Dep.(mn).

Data are summarized from a literature survey concerning fundamental theoretical aspects of radio-element absorption by the aerial parts of plants (leaves, flowers and fruits, base of the plants); the transfers in the plant; and the various factors governing absorption and transfers (physical, physico-chemical and biological factors). An attempt was made to evaluate radio-contamination risks which may result from irrigation by spraying with water contaminated by radioactive wastes. (157 references). (C.H.)

30007 THE RADIATION PROTECTION SHIELD. Stockhausen, J. Roentgen Bl., 16: 399(Dec. 1963). (In German)

A device is described that makes it easy to shield the abdominal region of male patients against direct irradiation. A column is mounted on a base plate supporting a plate at its top end. The top plate is covered with a 1 mn Pb plate. Because the radiation beam diverges, the plate is extended 2 or 3 cm in the cranial direction. In use the base plate is emplaced beneath the patient so that the leading edge of the top plate reaches to the level of the lower border of the symphysis. Whenever this shield is used, the fact that it does not shield against scattered irradiation should be taken into account. However, it does have the advantage that it is a simple, but direct means of protection against irradiation. (TCO)

30008 TISSUE DOSES OF THE BREMSSTRAHLUNG FROM ELECTRONS IN THE EARTH'S OUTER RADIATION BELT. D. P. Osanov, E. E. Kovalev, and G. B. Radzievskii. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 139-48(1964). (In Russian)

Protection against electron bremsstrahlung in outer space is discussed. Procedures and results of calculations of the spatial distribution of absorption doses and of the mean tissue absorption doses due to this bremsstrahlung are presented. The case of a cosmonaut leaving the cabin dressed in a space suit whose thickness is sufficient for the absorption of all the radiation belt's electrons is discussed. The calculations utilize data on the currents and spectra of electrons summarized by O'Brien and Van Allen. Graphs present the spectra of electron bremsstrahlung in materials of low atomic weight and the radial distribution of absorbed doses in an r = 23 cm sphere made of a tissue-equivalent material. (CFSTI)

30009 PROTECTION AGAINST PROTONS FROM SOLAR FLARES. V. E. Dudkin, E. E. Kovalev, L. N. Smirennyi, and M. A. Sychkov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 168-73(1964). (In Russian)

Calculations of astronaut protection against protons from solar flares were carried out using a method developed for the case of the flares of November 12, 1960 and February 23, 1956. They represent flare types A and B, respectively. The satellite cabin was assumed to be spherical and made of aluminum. The angular distribution of solar flare protons was assumed to be isotropic. Calculated absorbed tissue doses for the same flares as a function of tissue depth for various thicknesses of aluminum are presented. However, information about solar flares is insufficient for completely correct evaluations of the hazards. (CFSTI)

30010 PROTECTION AGAINST PRIMARY COSMIC RADIATION AND THE PROTONS IN THE EARTH'S INNER RADIATION BELT. V. E. Dudkin, E. E. Kovalev, L. N. Smirennyi, and M. A. Sychkov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 174-84(1964). (In Russian)

On the basis of data from 15 Soviet and Western references, the composition of primary cosmic radiation (PCR) was tabulated and the magnitude of the average tissue dose for various PCR components with and without protective layers was calculated. On the basis of data from 18 additional references for the inner radiation belt, the integral neutron flux ($E_p > 30$ Mev) as a function of altitude and geographic latitude, the proton spectra, the magnitude of the doses due to primary and secondary radiation as a function of shielding thickness, internal tissue doses as a function of shielding thickness, and the average tissue doses for astronauts in the vicinity of earth, in mber/day, are presented. (CFSTI)

Radiotherapy and Radiodiagnosis

Refer also to abstract 30539.

30011 (ACRH-103) MEETING OF THE ADVISORY COMMITTEE TO THE ARGONNE CANCER RESEARCH HOSPITAL PROGRAM, MARCH 4–5, 1965. Leon O. Jacobson, ed. (Argonne Cancer Research Hospital, Chicago, Ill.). Contract AT(11-1)-69. 170p. (CONF-650315). Dep.(mn); $5.00(cy), 3(mn) CFSTI.

Brief summaries are presented of research studies related to the radiotherapy of cancer during 1965. A list is included of 76 recent publications. Separate abstracts were prepared for eight sections of this report. (C.H.)

For abstracts of individual sections see: 29846, 29847, 29848, 29883, 29884, 30012, 30013, and 30014.

30012 (ACRH-103(p.76-103)) PROBLEMS IN SCANNING. (Argonne Cancer Research Hospital, Chicago, Ill.).

Problems in radioisotope scanning are summarized. Topics discussed include the response of collimators for radioisotope scanning systems; techniques that aid in quantitative interpretation of scan data; the design of collimators for γ ray cameras; the response of scintillation detectors to scattered radiation; the development of a precision scanning system employing digital drive and digital control techniques; the relation of resolution to sensitivity in radioisotope scanning; the design of a whole-body scanner for small animals using plastic scintillators; design modifications in whole-body and brain scanners; the use of ^{99m}Tc, ^{144}Pr, ^{113m}In, ^{38}K, ^{124}I, and ^{34}Cl as tracers for clinical studies; and the 3-dimensional display of radioisotope scanning data. (C.H.)

30013 (ACRH-103(p.104-20)) CLINICAL AND EXPERIMENTAL STUDIES ON THE EFFECTS OF RADIATION. (Argonne Cancer Research Hospital, Chicago, Ill.).

Summaries are presented of clinical and experimental studies on the effects of radiation. The impairment in delayed response following bilateral destruction of the dorsomedial nucleus of the thalamus was studied in Rhesus monkeys following the implantation of small ^{90}Y β sources in the thalamus. It was concluded that the dorsomedial nucleus is an essential component of the mechanism required for central retention of transient events, that the nucleus exhibits a high degree of equipotentiality in regard to this function, and that only a small remnant may suffice for normal performance. The destruction of small volumes of tissues, such as the pituitary hypophysis, with β sources is discussed. Applications of ^{90}Sr needles for percutaneous cordotomy for patients suffering from intractable pain, mostly due to terminal cancer, gave good results in 80% of 136 cases. Significant palliation was also achieved in 25 patients with a variety of inoperable lesions by the implantation of ^{103}Pd radiation sources. Data are summarized from studies on 250 persons carrying a significant body burden of Ra as a result of medical or occupational deposition. Data are included on malignancies attributable to Ra deposition. Results are reported from a study of the effect of bone marrow injections on radiation injuries in mice. The control of infections in irradiated mice is discussed. (C.H.)

30014 (ACRH-103(p.121-42)) STUDIES WITH HIGH-ENERGY RADIATIONS. (Argonne Cancer Research Hospital, Chicago, Ill.).

Therapeutic applications of high-energy radiation sources in the treatment of cancer are reviewed. The sources include a 2-Mev Van de Graaff x ray generator, a rotational ^{60}Co teletherapy γ machine, and a 50-Mev electron linear accelerator. The use of an analog computer in the calculation of radiation therapy doses and related uses is discussed. The modification of the radiation response of tissue by actinomycin, colchicine, AET, DMSO, and PAPP was

investigated in mice and the effects of actinomycin and colchicine on tumor radiosensitivity were studied in selected cancer patients. (C.H.)

30015 RESULTS OF THE TREATMENT OF BLOOD FUNGUS OF THE SKIN. Paul Ott and Hans-Juergen Frank-Schmidt (Stadtische Krankenanstalten, Mannheim, Ger.). Aerztl. Forsch., 19: 271-8(May 10, 1965). (In German)

Of patients with cavernous hemangiomas treated in time, i.e. during the first or second year of life with short-range x rays, 95% were cured with good cosmetic effect. The different radiosensitivity of other angiomas warrants caution in using radiotherapy. Extreme treatment methods and particularly impressive cases are illustrated. The characteristics of 237 cases of solitary or multiple hemangiomas, observed for five years after the first treatment, are evaluated statistically. (auth)

30016 RESULTS OF RADIATION DOSIMETRY IN TELECOBALT AND ROENTGEN THERAPY. Antero Voutilainen and Seppo Niklander (University Central Hospital, Helsinki). Ann. Chir. Gynaecol. Fenniae, 53: 357-63(1964).

This study attempted to establish the degree in which bone absorbs x rays of energy of over 200 kev, and whether the percent error of the dose rate at a certain depth deviates greatly from the percent dose rate of high-energy radiation emitted by ^{60}Co. Six cases of maxillary sinus tumor were treated with 240-kv x rays or ^{60}Co. To establish whether the calculated deep doses corresponded with experimental measurements, an ionization chamber was introduced at a measured distance into the maxillary sinus or nasopharynx. Measurements in epipharynxes are given in a table which shows the calculated and measured depth dose percent of the superficial dose. For ^{60}Co irradiation the measured dose was an average of 98% of the calculated depth dose. With x irradiation the measured dose average was 85% of the calculated depth dose. In measurements on maxillary sinuses the ionization chamber was introduced into the sinus via an operatively created aperture in the palate. The measured dose with ^{60}Co irradiation was an average of 99% of the calculated depth dose and with x irradiation 86%. Irradiation was given to one field only. The measurements gave very similar results in the 11 cases studied. The distance from the skin surface to the measuring point varied in different patients from 5 to 7 cm. When x irradiation is employed, a deduction of about 15% for water absorption must be made when the maxillary sinus or epipharynx is under treatment, i.e., the deep dose must be multiplied by the so-called tissue factor, in this case 0.85. The ratio between bone absorption and water absorption as a function of the half value layer (HVL) of radiation is shown. When a HVL of 2 mm copper is used in x-ray therapy, this ratio is 1.6. When 250 kv and a Thoraeus filter are used, HVL is 2.7 mm copper and the bone absorption/water absorption ratio falls to 1.3. When radiotherapy is administered via bony tissue, consequently, the radiation should have as great a HVL as possible to give an adequate tumor dose. When ^{60}Co γ radiation is used, the bone absorption/water absorption ratio ~1. Measurements established the value of the tissue factor as 0.98 to 0.99 for ^{60}Co γ radiation. The dose distribution in telecobalt therapy was measured on an anatomical phantom and the effect of bone absorption determined. Sixty % isodose, e.g., shows a distinct trough which is probably caused by the radiation absorption of several successive thick bone elements. For instance, 3 cm of compact bone inside a water phantom absorbs even ^{60}Co irradiation to such an extent that a deduction of 11% must be made form the calculated depth dose. About 50% should be deducted from the depth dose of x radiation in corresponding conditions. The dose distribution in the tumor area was good and the tumor dose could be calculated for 150% isodose which covers even the posterior part of the maxillary sinus inclusive of the pterygopalatine fossa. A dose of 4500 R may be given superficially in both treatment fields, the tumor dose being 6750 R. The 60% isodose curve runs roughly in the region of the medulla oblongata where the dose is 2700 R. Other critical organs need not be taken into consideration provided that primary radiation is not directed to the eyes. (BBB)

30017 EXPERIENCES WITH AMINOPEPTIDASE DETERMINATION IN THE URINE DURING DERMATOLOGICAL DISEASES. H. Bergmann and G. F. Klostermann (Universitats, Gottingen, Ger.). Arch. Klin. Exptl. Dermatol., 218: 603-10(Aug. 7, 1964). (In German)

A patient with mycosis fungoides received whole-body x-irradiation of 300 R with dermatological large field procedure at 50 kv. Several foci were treated similarly with 29-kv x irradiation. Within two days the urinary aminopeptidase activity began to increase from a normal value of ~2000 units/ml to values as high as ~8000 units/ml. In 10 patients with psoriasis and eczema, similar treatment with 200 R of whole-body x irradiation did not result in any marked increase of the average urinary aminopeptidase activity over an initial average value of ~500 units/ml. These patients were studied for 3 to 4 weeks after irradiation. Compared to the normal value of aminopeptidase activity in urine, which lies between 1500 and 2000 units/ml, these patients showed no response to the irradiation, suggesting that cell decomposition products did not exert a large effect on the urinary aminopeptidase concentrations. (TCO)

30018 HERPETIC KERATITIS TREATED WITH STRONTIUM-90. Rugero Bilucaglia and Romano Bilucaglia. Arch. Ofthalmol. (Buenos Aires), 39: 172(Apr. 1964). (In Spanish)

The effect of β radiation from ^{90}Sr on the cornea was noted in the course of treatment of 39 cases for herpes keratitis. The rationale of the treatment is based on the fact that β radiation produces a sharply localized inflammatory reaction (because of the low range of ^{90}Sr β particles), which is followed by regenerative processes in the cornea. Because of the low penetrability of the β rays, about 50% are absorbed in the posterior layer of the cornea and about 6% in the anterior portion. The patients treated had developed severe keratitis not responding to other forms of treatment. The treatment consisted of three to four applications of ^{90}Sr over 10 to 12 days to give total doses of 2500 to 3000 Rad. The ^{90}Sr was applied to the cornea and pericorneal conjunctiva. This resulted transiently in increased congestion and irritation of the tissues, followed by objective and subjective improvement, including relief from pain. Of the 39 cases treated with ^{90}Sr, 23 were considered completely cured with restoration of epithelial and stromal integrity. In six cases, inflammatory reactions continued for about a month. In four patients no improvement was obtained, and in four others the condition was aggravated by β irradiation. The results demonstrate the usefulness of ^{90}Sr treatment of herpes keratitis, especially of chronic cases. (BBB)

30019 FURTHER OBSERVATIONS ON THE HISTOLOGICAL MODIFICATION OF THE HUMAN LARYNX AFTER TELECOBALT THERAPY. V. Mattioli, O. Fini-Storchi, and L. Lippi (Universita, Florence). Boll. Mal. Orecchio, Gola, Naso, 82: 15-27(Jan.-Feb. 1964). (In Italian)

This study deals with the histological changes observed in patients with epiglottis carcinoma who received telecobalt therapy with focal doses varying from 4800 to 6000 R. Case 1 received 200 to 250 R on alternating days with a total dose of 4800 R. A slight erythema of the vestibule without edematous signs was observed at the end of the treatment. A total laryngectomy was performed six weeks after terminating radiotherapy. Case 2 received 38 sessions with total dose of 5940 R. The neoplasm disappeared after five months when the edema was in a regressive stage. Fourteen months later a progressive neoplasm was evident, and total laryngectomy was performed. Case 3 received 39 telecobalt sessions for laryngeal carcinoma with a total dose of 6000 R. The neoplasm regressed, but after two years a swelling appeared and patient received a new cycle of 13 sessions to 2340 R. The neoplasm regressed again, and diffuse inflammatory signs were observed. Ten weeks later a total laryngectomy was performed because of developing neoplasm in the arytenoid apex. Histological examination of the epiglottis showed nuclear pyknosis in the epithelial tunic with extensive cellular cytoplasmic vacuolar degeneration. The subepithelial and fibrous collagen layers

showed lymphocytic infiltrates, and the mixed glands were reduced in number. No noteworthy alterations were observed in the epithelial tunic of the false cord. The larger muscular fasciae showed decreased staining. No alterations were observed in vocal cord epithelium. The mucous membrane showed marked hyalinization and edematous separation of the layers. Extensive lymphocytic and plasmacellular infiltration was observed in the subepithelial layers of the arytenoid region but less than in the false cords. The mucous membrane showed marked edematous swelling. The thyroid cartilage was ossified in all patients and showed no alterations. This study confirmed that the late irradiation-caused changes in the mucous tunic and in elastic and hyaline cartilage were more marked in the patients with the higher doses of telecobalt therapy. In a varying period after radiotherapy, complete regeneration was observed in some mixed glands while others showed complete atrophy. In striated muscle, regressive signs were observed, with collagen replacement of entire muscular fasciae; however, some muscles were well preserved, and this gave the impression that the lesions will regress with time. No vascular lesions were observed even with the Weigert staining method for elastin. The changes observed in these biopsies appeared to be related to individual differences in radiotherapy tolerance. (BBB)

30020 THE TREATMENT OF CARCINOMA OF THE BLADDER BY SUPERVOLTAGE X RAYS. Robert Morrison and Thomas J. Deeley (Hammersmith Hospital, London). Brit. J. Radiol., 38: 449-58(June 1965).

Four hundred and twelve cases of cancer of the bladder treated by supervoltage radiotherapy were analyzed. The treatment policy is discussed in relation to the extent of the tumor, its histological pattern, and the probability of its spread in the bladder wall and to the pelvic lymphatic nodes. The techniques of treatment are described. The survival rates are given for the stage of the disease, the histological type, the site of the tumor in the bladder and its cystoscopic appearance. Lesions with extravesical spread to both sides of the pelvis were found to have a worse prognosis than those with a spread to one side. The reactions after treatment and the late complications are described and their incidence related to the tumor dose. The tumor response at different times after treatment was analyzed for the different histological types and the site of the lesion. The results of a small prospective investigation suggest that the disappearance rate does not increase with a higher tumor dose. Possible methods of improving the results are discussed. (auth)

30021 ON THE TECHNIQUE OF PEDICLE FLAP PLASTIC SURGERY FOR CHRONIC RADIATION ULCER. Wolfgang Axhausen (Universitats-Klinik, Hamburg/Saar, Ger.). Fortschr. Kiefer Gesichtschir., 8: 109-11(1962). (In German)

The use of pedicle flaps for covering skin defects resulting from persisting unhealed radioinduced lesions is described. The surgical technique is illustrated with reference to two cases. In one, a 49-yr-old woman developed a large ulcer on the neck 30 yr after x-ray therapy for tumor in cervical lymph nodes. The large defect was closed by a pedicle flap from the scapular region, with good cosmetic and functional results. In the second case, a 54-yr-old man developed a large, gaping ulcer at the base of the nose 14 yr after Ra treatment for a tumor. In this case a flap of skin was reflected from the forehead to the nose defect allowing for good nasal and optic function but only fair cosmetic results. These cases show that in the treatment of chronic radiation ulcers, pedicle plastic surgery is of particular significance. Although a proximal skin flap is technically simpler and therefore more desirable, the extent of the radiation damage frequently makes it unsuitable. Suitably long pedicle flaps allow skin to be brought from some distance even for extensive radiation burns. After sufficiently radical excision of the injured tissues the pedicle of the transplanted skin can be separated from the donor site as soon as it has obtained a sufficient blood supply from the surrounding skin or tissues. If the graft is situated in scar tissue or in an avascular area, it is best to maintain pedicle by embedding it at skin level to ensure sufficient nutrition and survival of the graft. This is the optimal way of avoiding failure and recurrence of the ulcer. In the cases illustrated here, good vascularization of the pedicle flaps was retained. Additional corrective measures can be made later on the graft to improve the cosmetic effect. (BBB)

30022 OBSERVATIONS ON FREE SKIN TRANSPLANTATION FOR THE TREATMENT OF DEEP-SEATED RADIATION INJURIES OF THE SKIN OF THE FACE. Eberhard Krueger (Universitats-Klinik fuer Mund-, Zahn-, und Kieferkrankheiten, Bonn). Fortschr. Kiefer Gesichtschir., 8: 122-30(1962). (In German)

Two cases are described in which chronic radioinduced ulcers developed. Histologic changes in the irradiated skin are described as well as plastic surgical techniques used to cover the defects. In the first case, a 53-yr-old woman, an ulcer on the neck developed 25 yr after x-ray treatment of hyperthyroidism. Biopsy of the lesion showed marked hyalinization of the dermis which was hypocellular. The epidermis was atrophic, with loss of papillae and glands. In the second case, a 15-yr-old girl developed a large ulcer below the eye years after Ra and x-ray treatment of a capillary hemangioma on the cheek. In the repair of such lesions, it is pointed out that free skin transplants used as substitutes for radiation-damaged skin frequently do not take completely since the bed may have been damaged by the radiation. A method is described of which the first stage is the excision of the damaged skin. The wound is allowed to granulate, the bandage being changed daily. Growth of granulation tissue is an indication of the vitality of the underlying radiation damaged tissues. Areas without granulation tissue are excised. When there is a complete cover with granulation tissue, the wound is covered with split skin grafts, following several days of antibiotic administration. Fibrin and layers of epithelium on the margins are removed before the transplant is carried out. The procedure is illustrated by these two cases which were subsequently examined histologically. It was shown that granulations arising in radiation-damaged tissue are not as vigorous as those from normal tissue. When excising the wound, it is therefore important to remove only the fibrin deposits but not the granulation tissue. (BBB)

30023 ROUTINE RADIOLOGICAL EXAMINATIONS AND RADIATION HAZARDS. J. Remy and H. Cheradame. Gaz. Med. France, 70: 2993-3003(Oct. 25, 1963). (In French)

The authors discuss and define radiological units and criteria such as the Rad, Rem, RBE, and maximum permissible dose limits. These and other related factors are important in a systematic program where about 60,000 persons are subjected to thoracic x-ray examinations annually. Using 85-kv x ray for a skin dose that varies between 35 and 55 mR for each exposure, the gonadal dose is 55 μR. For a skin dose of 180 to 250 mR, the gonadal dose is 205 μR, and for a skin dose from 900 to 1400 mR, the gonadal dose is 380 μR. For x-ray photographs at 110 kv the skin dose is between 100 and 150 mR. At the values measured the somatic and genetic risk involved is very small. It would be most desirable if the number of fluoroscopic studies could be reduced as far as possible, replacing them as much as possible with radiophotography. This would reduce the radiological risks very much without impairing diagnostic usefulness. Out of a total of 58,000 persons examined by x ray, 225 new cases of tuberculosis were detected. This is equal to a detection rate of 0.387%. (BBB)

30024 EARLY RESULTS FROM USE OF TELECOBALT THERAPY IN THE TREATMENT OF PATIENTS WITH CERVICAL CARCINOMA. Julius Weishaar (Universitat, Erlangen, Ger.). Geburtsh. Frauenheilk., 25: 3-8(Jan. 1965). (In German)

The 2-yr survival rates of patients with cervical carcinoma at various stages of tumor development were not significantly different whether they were treated with Ra implantation combined with telecobalt therapy or x ray.

The daily focal telecobalt dose was about 170 to 180 R, and the total dose amounted to 2800 to 3500 R. The daily dose of x ray was between 160 and 180 R, with the total dose amounting to 2500 or 3500 R. The side-effects produced by the two procedures were restricted essentially to early effects on the skin. The incidence of leukemia was slightly higher in the patients treated with telecobalt as compared to those treated with x ray, but the difference was not significant. Although the patients treated with x ray generally were more obese than those treated with telecobalt irradiation, this difference also had no effect on the survival rates observed. (BBB)

30025 THE ACTION OF EXTENSIVE RADIOTHERAPY ON THE LYMPHATIC METASTASES OF UTERINE CERVICAL CANCER. J. Botella Llusia (Universidad de Madrid). Gynecol. Obstet., 63: 5-12(Jan.-Mar. 1964). (In French)

Cases of cervical cancer in stage three underwent an extraperitoneal pelvic lymphadenectomy and were divided into five groups. Group I (50 cases) received no radiotherapy; Groups II to V (15 cases each) received 10,000 to 11,000 mg-hr Ra intravaginally and intracervically. In addition, Group III received 3000 R and Group IV, 4000 R of conventional x-ray therapy. Group V received 5000 R of ^{60}Co therapy. Twenty to 30 days after therapy, the lymph nodes were removed and examined histologically. Metastases were found in 34% of Group I, 33% of Group II, 20% of III, 13% of IV, and 6.7% of V. Thus, radiotherapy acted on metastases in proportion to its dose and intensity. In no series was it possible to obtain sterilization of the lymph nodes. Surgery with lymphadenectomy and depth radiotherapy is the only valid technique for destruction of uterine cervical carcinomas. A study was made of lymphatic invasion according to the histological type. The lowest frequency of invasion (3.5%) was with the basocellular type, the least with lymphotropic cells. The frequency was 57.1% with the spinocellular type, and 87.5% with adenocarcinoma, the most lymphotropic cells. The histological structure of the tumor is much more important than the clinical stage for determining the frequency of lymphatic invasions. Basocellular cancer should be treated as follows: stage one: Ra or operation without lymphadenectomy and external radiotherapy; stage two: Ra + operation; stage three: Ra + external radiotherapy. Spinocellular cancer and stages one and three adenocarcinoma should be treated as follows, stage one: operation with lymphadenectomy + radiotherapy; stage two: Ra + operation + external radiotherapy; stage three: Ra + extraperitoneal lymphadenectomy + radiotherapy. Stage two adenocarcinoma should be treated by operation without Ra or external radiotherapy. (BBB)

30026 SHOULD ONE FORBID UROGRAPHY IN OBSTETRICS? G. Patoir and E. Spy. Gynecol. Obstet. (Paris), 62: 709-14(Nov.-Dec. 1963). (In French)

Irradiation during urography has two main risks. The first of these is the possibility of genetic change, but this factor is difficult to evaluate. Somatic effects are more measurable, and include, as examples, fetal malformations, reduction of life span, or hematological disorders, such as leukemia. The skin dose usually given amounts to somewhere between 450 and 600 mR. This is rapidly attenuated over the first few cm. The anterior portion of the fetus absorbs about 25% of the dose measured at the skin surface, and the posterior portion of the fetus receives about 1 or 2% of the skin dose. In order to reduce the risk of genetic damage or somatic damage from urography during pregnancy several measures can be taken. These include the deferral of urographic examinations until after the period of organogenesis, reduction of the dose by decreasing the number of exposures, more exact centering, and narrowing of the diaphragm. One or two exposures should be sufficient for these studies. Other procedures that can be used to reduce the dosage are increased voltage to reduce the number of exposures, increased filtration to exclude scattered radiation, and fast film, with image intensification. In conditions where there may be any question of fetal damage that might result from a urographic examination it is the obstetrician's responsibility to make the decision as to whether it is justified by the patient's condition. (BBB)

30027 THE HANDLING AND DISPENSING OF XENON-133: GAS SHIPMENTS FOR CLINICAL USE. N. Veall (Guy's Hospital Medical School, London). Intern. J. Appl. Radiation Isotopes, 16: 385-7(June 1965).

An apparatus for dispensing ^{133}Xe for inhalation studies is described that uses a 50 ml glass tonometer fitted at either end with a short length of rubber tubing that can be closed by screw clips. Procedures and equipment for the preparation of ^{133}Xe solutions for use in diagnostic studies are also described. (C.H.)

30028 WHAT NURSES SHOULD KNOW ABOUT RADIATION HAZARDS. Edith H. Quimby (Columbia Univ., New York). Intern. Nursing Rev., 11: 18-22(Aug. 1964).

Hazards to nurses caring for patients undergoing treatment with x rays, Ra, and radioactive isotopes are discussed. The quantities of radiation necessary to bring about pathologic changes are in general far greater than any nurse would receive in carrying out her duties. The International Commission on Radiological Protection maximum permissible doses for persons either working with x rays or radioactive materials, or caring for patients, amount to 5 rad per year. Therefore precautions for the nurse working in the lab or with patients undergoing treatments with radioactive materials must be directed toward keeping exposures below this level. This is readily accomplished. When radioactive isotopes are used only for diagnostic tests, the amounts of radiation associated with the patients are so small that they never are cause for concern to nurses. Sources of radiation hazards to nurses are threefold: (1) Irradiation by the radioactive material in the patient. (2) Accidental contamination of the skin by radioactive material in the course of patient care. (3) Accidental ingestion of radioactive material (possibly by smoking or eating when the hands are contaminated). There is no external hazard from patients who have received <5 mC of any radioisotope. If such a patient vomits or is incontinent within the first 24 hr, care should be taken to avoid contaminating the skin during the clean-up operations. Rubber gloves should always be worn when there is any possibility of skin contamination. The hazards increase with increased level of dose. General instructions are given for care of patients who have received more than 5 mC of an isotope. External irradiation from patients may be reduced to a low level by spending a min of time close to patients who have received therapeutic doses. Tables are given showing maximum daily times which may be spent at different distances from patients containing various amounts of radioactive materials. These times are based on a total annual exposure of 3.6 rad, which is well below the maximum permissible. Except for large quantities of Ra or radiocobalt the nurse will seldom need to spend anything like the permitted time near the patient. For these two substances, particularly if there are many patients in the course of a year, the nursing load will need to be apportioned. (BBB)

30029 A STUDY OF PITUITARY FUNCTION AFTER INTRACELLULAR IMPLANTATION OF ^{90}YTTRIUM. E. Perry McCullagh, Marvin A. Feldstein, Devina C. Tweed, and Donald F. Dohn (Cleveland Clinic Foundation). J. Clin. Endocrinol. and Metab., 25: 832-42(June 1965).

Yttrium-90, contained in plastic cylinders, was implanted into the pituitary gland in 90 patients by the transnasal route through the anterior sellar well. Thirty-three cases are reported in which follow-up endocrine laboratory studies were done 6 weeks or later postoperatively and tentative clinical evaluations were made. Twenty-nine of the patients had metastatic breast cancer, 2 had acromegaly, and 2 had Cushing's syndrome. The degree of hypopituitarism induced was evaluated by preoperative and postoperative measurements of protein-bound iodine (PBI), basal metabolic rate (BMR), urinary gonadotropins, 17-ketosteroids (17-KS), and 17-hydroxycorticoids (17-OHCS). Based on the urinary excretion of 17-OHCS in response to administered Metopirone postoperatively, 21 of the 29 patients with metastatic breast

cancer had severe hypopituitarism, and most had subjective and/or objective benefit from the operation. Eight of the 29 patients judged by response to Metopirone had residual pituitary function ranging from one of limited degree to normal. None of these 8 had objective remission in progression of the cancer, although 3 claimed subjective relief. Dramatic subjective and objective improvement occurred in the patients with acromegaly and Cushing's syndrome. There was no strict correlation between gonadotropin output postoperatively and urinary steroid levels in response to administered Metopirone. The data would suggest that of the tests employed the urinary gonadotropin titer was the most sensitive measure of pituitary destruction. Attention is called to the fact that for some patients there is considerable variation in degree of abnormality in the various postoperative assays of hormones. (auth)

30030 SOME PHYSICAL FACTORS AFFECTING IMAGE QUALITY IN MEDICAL RADIOGRAPHY. Rossmann, K. (Eastman Kodak Co., Rochester, N. Y.). J. Phot. Sci., 12: 279-83(Sept.-Oct. 1964).

The use of fluorescent intensifying screens in conjunction with film produces higher film contrast and increased system speed. It also results in reduced sharpness due to light diffusion in the screen-film sandwich, and in a coarser grain pattern (quantum mottle) due to spatial fluctuations of the x-ray quanta. The light diffusion (line spread-function) was measured by means of exposure through a narrow slit. The calculated modulation transfer function yields resolutions of 6 to 10 cycles/mm for typical screen-film systems. Because of this great unsharpness, linear transfer theory can be used to explain the recording of quantum mottle. From the resulting expression for the power spectrum of mottle, the standard deviation of the density fluctuations in the mottle pattern was calculated. It is shown how the various system parameters affect the recording of quantum mottle. (auth)

30031 ON A SELECTIVE IRRADIATION PROCEDURE WITH INTERNAL BEAMS. J. Andrade E. Silva and G. Lochak (Universite, Paris). J. Phys., (Paris), 26: 97A-103A(Mar. 1965). (In French)

The method of selective irradiation is subjected to a critical study in order to define its range of applicability and stress the precautions that should be borne in mind when using it. (auth)

30032 THE USE OF I-125 ORTHO-IODOHIPPURATE FOR LOCALIZING THE RADIOISOTOPE RENOGRAM PROBES. Donald W. Brown (Univ. of Colorado, Denver). J. Urol., 93: 502-3(Apr. 1965).

An improved technique of radioisotope renography is described in which ^{125}I-labeled o-iodohippurate is used to localize the dual probes over the kidneys preceding the usual ^{131}I-labeled hippurate renogram. This procedure offers the following advantages: excellent localization of the scintillation probes; the renogram can be recorded on a base line which is zero; abnormal renal positions can be located before the renogram is performed; and a proper sensitivity setting on the strip chart recorder can be selected before the renogram is performed. To conduct the test, 15 μC of ^{125}I-o-iodohippurate is injected intravenously. About three min later, twin, well-collimated probes containing 2-in. crystals are placed for maximum count rate and their position clearly marked. A window from 15 to 50 kev is used on the dual pulse height analyzers. Five minutes after the ^{125}I injection, and after changing the window settings to 310 and 410 kev, the patient is given intravenously, 0.9 μC/kg of ^{131}I-o-iodohippurate. A 20-min scan recording is made. If an abnormal location of one or both kidneys is detected or one side is found to be abnormal, the test can be repeated with the patient in the prone. In addition, the hippurate renogram with a ^{203}Hg renogram and scan may also be carried out. Results obtained with 51 renograms using this technique are summarized. (TCO)

30033 BONE FRACTURE AND PREGNANCY. G. Gelehrter (Arbeitsunfallkrankenhaus Graz der Allgemeinen Unfallversicherungsanstalt, Graz, Austria). Klin. Med. (Vienna), 18: 630-4(Dec. 1963). (In German)

Pregnancy can influence the characteristics and methods of treatment of bone fractures. Protection from radiation is very important here. It is known that x irradiation can induce fetal malformations, leukemia, etc., even at very low doses. Even doses to the pelvis as low as 25 R can lead to malformations, especially during the period of from 11 to 45 days after conception. During the first 10 days after conception irradiation can cause fetal death. The danger of this type of injury is so great that if a fetus should receive more than 10 R during the first 4 months of pregnancy, then the pregnancy should be terminated. Therefore, during diagnosis and treatment of bone fractures great care should be taken as to the amount of irradiation used. The fetus and gonads should be shielded against scattered radiation by Pb sheets, even when x-ray photographs of the extremities are taken. Much greater care must be taken when areas near the pelvis, hips, or upper portions of the leg are examined. (BBB)

30034 VERTICAL MOVING SCREEN CONSISTING OF TWO MOBILE PARTS FOR RADIATION PROTECTION. Imre Eloed, Bela Rossmann, and Istvan Szuromi. Magy. Radiol., 15: 119-20(Apr. 1963). (In Hungarian)

A detailed description together with a diagram is given of the construction of a stand to hold a Bucky-type screen, and two movable protective shields. The structure is made of 50-mm metal tubing and has a pair of pulleys for the supporting cables of 480 × 650 mm lead-rubber shields. The screen moves on runners installed in the structure and balanced by counter weights. The lead shielding is also provided with individual lead counter weights for easier mobility. Thus the patient receiving diagnostic x rays can be shielded from above and below to expose only the area to be examined. X-ray pictures to be taken without the screen can be done by sliding the x-ray apparatus on rails provided for that purpose. Small springs and levers installed in the structure make it possible to adjust the apparatus easily with one hand. The structure can be mounted on a wall. An experienced machinist can produce this structure in 3 to 4 days and the cost of material is minimal. (BBB)

30035 TREATMENT OF THE COMPLICATIONS AFTER THE WERTHEIM-MEIGS OPERATION AND AFTER IRRADIATION OF CANCER OF THE UTERINE CERVIX. Joao B. Vianna (Instituto Nacional de Cancer, Rio de Janeiro). Med. Cir. Farm., 304: 77-93(Mar.-Apr. 1963). (In Portuguese)

Urologic complications of surgical and/or radiation treatment of cervical carcinoma in 23 cases are described, as well as surgical procedures used to repair these lesions. The patients had been submitted to the Wertheim-Meigs operation and Ra or x-ray therapy. The resulting lesions in the 23 cases could be divided into nine cases of uretero-vaginal fistulas (four of the simple type and five with associated ureteral stenosis), five cases of hydronephrosis from cicatrical ureteral stenosis (three unilateral and two bilateral), and nine cases of vesicovaginal fistulas (six of the simple type, two with ureteral impairment, and one with urethral impairment). Surgical repair of postirradiation fibrosis and stenosis of the distal third of the ureter consisted mainly of removal of the scarred segment and reinsertion of the healthy end into the bladder wall. The surgical technique is illustrated. When more extensive scarring of the ureter was present, requiring removal of a longer segment, the lower portion of the ureter was reconstructed by creating a flap from the bladder wall which was then split longitudinally through the center to form a tube-like structure. The free end of the ureter was then inserted through the tunnel so created between the mucosal and muscular layers of the flap and sutured into place. In very extensive or bilateral ureteral stenosis, the ureters were reconstructed from segments of ileum; two such cases are described and illustrated. Other methods of surgical repair of postirradiation ureteral damage are also described which required uteroileostomy in one case and ureterostomy in another. Several plastic surgical techniques for correcting vesicovaginal fistulas are also explained, with reference to three cases. When such a condi-

tion compromises ureteral function, it is recommended that the Marshall operation be carried out with reimplantation of the corresponding ureter. (BBB)

30036 RADIOISOTOPE SCANNING IN THYROID DISEASE. J. Myhill, I. B. Hales, T. S. Reeve, I. D. Thomas, and T. H. Oddie (Royal North Shore Hospital, Sydney). Med. J. Australia, 2: 6-11(July 4, 1964).

Use of ^{131}I for thyroid scanning in a series of patients is described, with emphasis of observations on safe practices, technique, instrumentation, as well as results and their applicability to clinical diagnosis. Since radioactive thyroid scanning is generally contraindicated in a child, owing to the relatively large dose of radiation involved, only one child was scanned in whom it was important to determine whether a mass at the base of the tongue was thyroid tissue. The aim of this study was to minimize the radiation dose delivered to both the thyroid gland and the whole body, while ensuring that sufficient radioiodine was taken up by the thyroid for adequate delineation of the borders of the gland, and for differentiation of the function of any nodules within it. The quality of the scans obtained depended on the specific concentration of isotope within the area being scanned. Therefore, to obtain a good scan, larger goiters required larger doses. Less radioiodine was required for a patient whose thyroid gland was avid for iodine than for a patient whose thyroid gland was functioning more slowly. For accurate delineation of a nodule, a relatively larger ^{131}I dose was used, to reduce the statistical fluctuations involved in the γ-ray detection of the isotope. These fluctuations may cause the boundaries between functioning and nonfunctioning tissue to become indistinct. Doses of 30 to 200 μC of ^{131}I were generally administered orally, though occasionally intravenously. The radiation dosage to the thyroid gland was estimated at 30 to 250 Rad; that to the gonads was 0.01 to 0.07 Rad. This compares with 0.3 Rad received by the ovaries during an x-ray examination of the pelvis. Another aim was to perform the scan as soon as possible after administration of the dose. The time between administration of the dose and scanning varied from two hr for a patient whose clearance rate was 16×10^{-3} min^{-1}, to four days for a patient whose clearance rate was 1×10^{-3} min^{-1}. The euthyroid range was about 1.0 to 5.4×10^{-3} min^{-1}. The results confirmed that radioisotope scanning delineates the borders of the normally functioning thyroid gland, and the position of aberrant thyroid tissue. The scan is a useful guide to surgeons planning an operation in these situations. (BBB)

30037 A COMPARATIVE ASSESSMENT OF METHODS OF RADIUM THERAPY OF HYPOPHYSEAL TUMORS. A. N. Gamaleya, M. D. Donskoi, M. A. Merkova, and T. Zh. Shvedova (Budenko Main Military Hospital, Moscow and Roentgen-Radiological Scientific-Research Inst., Moscow). Med. Radiol., 10: No. 4, 3-11(Apr. 1965). (In Russian)

A comparative assessment of methods of static distance gamma- and roentgen-therapy of tumors of the hypophysis is presented. On the basis of phantom measurements and construction of isodose curves the authors demonstrate that gamma-irradiation from two fields enables application of a focal tumor dose of 6,000 to 7,000 Rad, with insignificant energy absorption by healthy tissues, whereas in roentgen-therapy the focal dose of about 300 Rad requires irradiation from not less than five fields. Clinical observations disclosed that in gamma-therapy the dose of 6,000 to 7,000 Rad per course of treatment produces a stable normalization of the process, whereas in x ray therapy such results require three to four treatments. The general and local reaction of hypophyseal tumors to gamma-therapy is less than in x-ray therapy, even though larger doses were used in γ therapy. (auth)

30038 THE IMPORTANCE OF THE METHOD OF RADIUM THERAPY IN MILK-DUCT CARCINOMA. A. V. Koziova (Scientific-Technical Roentgen-Radiological Inst., Moscow). Med. Radiol., 10: No. 4, 12-19(Apr. 1965). (In Russian)

A study of the results of treatment of 257 patients suffering from milk-duct carcinoma shows that in the second and third stages of the disease a radical operation with previous or subsequent x-ray therapy (the total dose not exceeding 2,000 Rad) does not prevent the development of relapses and metastases in the zone subjected to irradiation. In instances when the operation is combined with gamma therapy, in which the total field dose is elevated to 3,500 to 4,000 Rad, relapses and metastases are observed more rarely and at later periods. In milk-duct carcinoma recurrence of the neoplastic growth is seen not only at early periods, but also 5 to 10 years after the operation, thus requiring observations over patients till the end of their lives. Gamma therapy in relapses and metastases of milk-duct carcinoma may be effective not only at early stages of the disease, but also in extensive distribution of the process. (auth)

30039 BETA RADIATIONS IN DERMATOLOGIC THERAPY. RADIOBIOLOGICAL CONSIDERATIONS AND GENERAL CLINICAL INDICATIONS. PRELIMINARY TESTS WITH β-EMITTING PREPARATIONS OF RADIO-STRONTIUM-RADIOYTTRIUM. G. Lovera (Universita, Turin). Minerva Med., 53: 997-1001(Apr. 4, 1962). (In Italian)

β radiation, which differs from x-ray and γ radiation in having corpuscular characteristics, is of great interest in radiotherapy, firstly, because of its low penetration in the irradiated matter and, secondly, the absorption mechanisms in the matter. Penetration of β radiation in living matter depends on the energy of the electrons and increases correspondingly. Absorption of the radiation energy between the surface and the point of maximum penetration is nearly uniform. In radiations with energies up to 15 Mev the dose falls rapidly to zero within a few centimeters. Thus with β radiation of 1.5 Mev the absorbed dose is 100% in a depth of 0.15 cm, 90% at 0.25 cm, and 10% at 0.5 cm. With radiation of 5 Mev the dose is 100% at 0.60 cm, 90% at 0.9 cm, and 10% at 2 cm. While x ray and γ radiation cause considerable diffuse ionization over the entire path, β radiation produces a linear ionization with little diffusion. On the basis of results achieved in this clinic with β radiotherapy, there appears a lesser biological activity, about 50% in comparison with x rays. Phosphorus-32 emits low-energy β radiation and 48% is absorbed in the first mm of tissue. The best source of β radiation is derived from ^{90}Sr and ^{90}Y as applied in dermatology. The electrons emitted by these radioisotopes which are of high intensity are advantageous in precancerous small lesions, over x rays, because of their absence of postirradiation side-effects. On the basis of the results obtained in this clinic, β radiation from ^{90}Sr and ^{90}Y in its present form is inconvenient for proper dosimetry and the use of a lead slit with a special ionization chamber is indispensable. This clinic uses disk applicators containing 50 μC of ^{90}Sr which are of 12 mm dia with the lower side in contact with the skin made of a nickel–steel alloy of 0.3 mm thickness, and the lateral walls are made of steel thick enough to completely stop the β radiation. For extensive lesions a sheet of thin, curved Plexiglas is used which permits the disk to move freely over the lesion. Observed doses were 3140 R/min on the skin surface with contact applicator and 1500 R/min with the Plexiglas applicator. At a depth of 5.2 mm the dose is reduced by 10%, and at 8 mm no measurable ionizing radiation was noted. (BBB)

30040 PUBERAL METRORRHAGIAS AND THYROID FUNCTION: RELATIONSHIP AND EVOLUTION. A STUDY WITH ^{131}I. M. Maneschi, E. Cittadini, and P. Quartararo (Universita, Palermo, Italy). Minerva Nucl., 9: 47-50 (Jan.-Feb. 1965).

The results of tests of thyroid function with ^{131}I and other techniques in six cases of puberal metrorrhagia in which the patients were kept under observation for from 5 to 20 months after the metrorrhagia, are reported. A high radioiodine uptake was found in these subjects (mean value, 75% 24 hours), as well as increased hormone formation without clinical symptoms or an increased basic metabolism rate in some cases. In these patients the renal radioiodine clearance was always sub-normal. After critical normalization of the clearance, the thyroid function tended to return to normal within about one year, provided the causes requiring this compensating increase of the thyroid

function (such as absolute or relative hyperfolliculinism and the cessation of increased pituitary secretion with its direct and indirect effects) were also removed. (auth)

30041 RADIOISOTOPE TREATMENT OF TUMOURAL MASSES IN THE RAT BY INFILTRATION WITH ^{131}I-LABELLED LIPIODOL. EXPERIMENTAL RESULTS. G. de Renzi, A. Bartorelli, S. Marchi, L. D'Ambra, and R. Ciampa (CAMEN, Pisa, Italy). Minerva Nucl., 9: 50-4 (Jan.-Feb. 1965). (In Italian)

A preliminary investigation on the use of ^{131}I-labeled Lipiodol UF in radioisotope therapy was carried out by directly infiltrating tumoral masses (Oberling-Guerin's myeloma and IRE sarcoma) in the rat. Complete remission of Oberling-Guerin's myeloma was observed, whereas in the animals with IRE sarcoma the effect consisted only in a slower development of the tumor as compared with the controls. The use of ^{125}I-labeled Lipiodol is proposed in order to utilize the different types of radiation, its longer half life, and the possibility of reducing the injuries outside the site chosen for irradiation. (auth)

30042 VESICAL CALCULOSIS AS A COMPLICATION DUE TO RADIOSURGERY TREATMENT OF VESICAL TUMORS. M. Chiaudano and G. Sesia (Ospedale Maggiore, Turin). Minerva Urol., 15: 141-7(Sept.-Oct. 1963). (In Italian)

This study deals with 28 patients who underwent irradiation and surgery in the urinary tract, of whom five presented vesical lithiasis. In Case 1, with tumor in the left prostatic region, partial cystectomy was performed with insertion of six Ra needles. One yr later telecobalt therapy was administered and was followed by vesical calculus one yr later. In Case 2, one year after surgery because of laryngeal carcinoma, formation of papilliferous neoplasm occurred which was surgically removed, and Ra needles were inserted into the bladder. Three years later radiotherapy was given due to hematuria, and three months later a vesical calculus was eliminated, the patient dying three months afterwards due to pulmonary metastases. In Case 3, a papilloma with proliferation in the posterior vesical wall was removed by vesical resection, with insertion of Ra needles; and one month later telecobalt therapy was followed by hematuria and cystoscopy revealed an adhering calculus in the vesical trigone. In Case 4, a papilloma with proliferation in the right posterior wall was surgically removed, and Ra needles were inserted. One year cystography showed the presence of a calculus which was surgically removed after radiotherapy. In Case 5, neoplasm in the posterior vesical wall was treated with 20 sessions of radiotherapy to a total dose of 6000 R. One month and a half later a calculus was passed. It appears that there was a relation between irradiation and surgery and lithiasis in these patients. It is suggested that the radiotherapy produces a degenerative state in the ground substance of the tissue which is conducive to the precipitation of Ca salts. With regard to the pathogenesis, only the transcutaneous pre- and postoperative radiotherapy appeared to be a causal factor. Common therapeutic postoperative measures were not sufficient to prevent such complications, but better results may be obtained using litholytic instillations. (BBB)

30043 CRITICAL FACTORS IN TREATMENT OF VOCAL CHORD CARCINOMA. K. Jatho (Universitats-Hals-Nasen-Ohren-Klinik, Cologne). Monatsschr. Ohrenheilk. Laryngo-Rhinol., 97: 210-20(Mar.-May 1963). (In German)

For treatment of unilateral vocal chord carcinoma the better methods available are chordectomy with laryngeal fissure or Ra contact irradiation. Protracted, fractionated treatment with x irradiation alone or combined with contact irradiation, with surgical exposure of the irradiation field has also given good results. Ra contact irradiation seems to be superior to chordectomy, because structure and function of the vocal chords are retained, and the voice is usually unimpaired. Complications, such as delayed healing or perichondritis are very rarely observed. In the procedure described for this treatment a Ra source of about 10 mg, encased in a 10 × 12.4 × 20.4 mm Pb and brass cassette is emplaced within a window prepared in the wall of the larynx by surgery. Dosages administered to the interior of the larynx may range from 1200 to 1680 mg-hr. For 10 mg of Ra the dose amounts to about 10000 R at 10-mm distance, where many carcinomas are situated, on the average. This treatment also has the distinct advantage that the soft tissues are not irradiated as much as when tumor doses of 4000 to 5000 R are administered by x irradiation. (BBB)

30044 THE PROBLEM OF THE ESTIMATION OF THE RADIOCURABILITY AND THERAPY OF LOCAL RECURRENCES IN CANCER OF THE UTERINE BODY. B. Belohorsky and E. Klauber (Oncological Research Inst., Bratislava). Neoplasma, 12: 45-50(1965).

Methods, mainly curettage, for following the effects of radiation on uterine cancer are discussed with reference to 177 cases treated with x rays and/or Ra. Successful hysterectomy after high-dosage Ra therapy (8500 to 9300 mg-hr) is reported in two cases. (BBB)

30045 FUNDAMENTAL STUDIES ON LINEAR SCANNING. Masanao Kawana (Chiba Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1460-71(Mar. 1964). (In Japanese)

Results obtained with linear scanning which rapidly determines the longitudinal distribution of radioisotopes deposited in the whole body are presented. The linear scanning device described was designed by the Department of Radiology, Chiba University and manufactured by the Toshiba Electric Co. Experiments were performed by using various kinds of phantoms bearing radioisotopes. Of the methods of counting evaluated, an integral method, a discrimination method, and a differential method, the differential counting method gave the best resolution in scanning. Using the integral method, small sources may not be resolved from the surrounding larger sources. A parallel collimator was preferred to a tapered one for resolution. Although the former is adequate for diagnosis, the tapered collimator is more useful for detecting small quantities of radioisotopes. As a detector, an NaI crystal of size 3 × 2 in. gave better sensitivity than one of 2 × 2 or 1 × 1 in. Among these three NaI crystals the differences in resolution were not significant. Crystals of 4 × 1 in. size gave almost the same performance as 2 × 2 in. with regard to sensitivity as well as resolution. Sensitivity factors were examined with a body phantom by using a single detector and collimator. A higher count rate was shown at the center of the collimator than on the side. Marked differences of count rates were shown in vertical directions according to the distance from the crystal. By using two detectors, opposing each other and arranged above and under the body at a certain distance, the difference of sensitivity in the vertical direction was minimized. By using two detectors arranged in parallel above the body, changes of the distribution of sensitivity in the horizontal direction were not seen over a certain range of distances. Therefore, by using several detectors properly arranged, uniform sensitivity could be obtained within a finite area in the vertical plane. Examples of whole-body scans obtained with ^{51}Cr, ^{59}Fe, ^{131}I, ^{131}-Diodrast, ^{131}I-Rose Bengal, and ^{198}Au are illustrated. (BBB)

30046 THE EVALUATION OF QUANTITATIVE I^{131} DISTRIBUTION IN THE THYROID GLAND—USING LEAD DIAPHRAGMS. Andrzej Kapuscinski. Polski Przeglad Radiol. i Med. Nuklearnej, 29: 199-206(Mar.-Apr. 1965). (In Polish)

A method of quantitative ^{131}I distribution estimation in the thyroid is presented. The estimations are performed 24 hrs. after the administration of the isotope and uses full and perforated lead diaphragms (with various diameters). The measurements are recounted in percents, the 100% representing the total thyroid gland radioactivity after 24 hrs., counted in impulses per minute. The evaluation of ^{131}I localization in the thyroid lobes or in its isthmus may be done using the full lead diaphragm, while the application of perforated diaphragms permits quantitative estimation in sites of thyroid tumors. (C.H.)

30047 ANIMAL EXPERIMENTAL EXAMINATIONS OF THE STABILITY OF ^{131}I-IOTHALAMAT IN METABOLISM.

R. Barke (Karl-Marx-Universitat, Leipzig). Radiol. Diagn., 6: 197-200(1965). (In German)

Rats were intraperitoneally injected ^{131}I-labeled iothalamat in physiological doses. Beginning with the seventh hour after the contrast medium had been applied the animals were killed and the activity in the blood and thyroid gland was determined. The thyroid values are of the same order as in earlier experiments with labeled visotrast and labeled triopac. Therefore, iothalamat being the chemically more stable compound compared to azetrizoat and diatrizoat, is also supposed to be able to be deiodised to some extent in metabolism. (tr-auth)

30048 CLINICAL OBSERVATIONS ON THE CHEMO-RADIOTHERAPEUTIC ASSOCIATION IN THE TREATMENT OF MALIGNANT TUMORS. G. Agati and I. M. Stoppa (Universita, Turin). Radiol. Med., 61: 113-33(Feb. 1965). (In Italian)

After recalling the theoretical bases justifying the chemo-radiotherapeutic association in the treatment of malignant tumors, the authors discuss the mechanisms of action of ionizing radiations and alkylating substances which are similar under many aspects. Results are reported for 127 patients suffering from malignant tumors of varied nature treated with radiotherapy combined with a chemotherapeutic drug (cyclophosphamide). The results obtained and the side effects observed are analyzed. (tr-auth)

30049 RADIOIODINE TREATMENT OF HYPERTHYROIDISM (TRENDS AND RESULTS OF THE G. ROUSSY INSTITUTE). E. Pignataro (Instituto Gustave Roussy, Villejuif, France and Universita, Siena, Italy). Radiol. Med., 61: 151-60(Feb. 1965). (In Italian)

Results obtained using radioactive iodine in the treatment of hyperthyroidism are reported. The diagnostic tests preceding and accompanying treatment are mentioned and the mode of performing radiotherapy with radioiodine is then discussed. The possibility of the appearance of a hypothyroid state and the risks of a cancerogenic, leukemogenic, and genetic effect are considered. (tr-auth)

30050 RECENT PROGRESS IN SCINTIGRAPHY. SELECTIVE PHOTOGRAPHIC ANALYSIS OF THE IMPULSES IN THYROID PATHOLOGY. P. d'Amico, S. Giavelli, and L. Roncoroni (Universita, Milan). Radiol. Med., 61: 161-78(Feb. 1965). (In Italian)

Automatic scanning equipment and pin-hole scintigraphic cameras are described. Results are reported for 15 cases of thyroid disorders examined with the Nukab photographic registration scanner which permits selective analysis of the recorded impulses that illustrate the better diagnostic possibilities of the scanner in the search for, and study of, zones of non-homogeneous fixation of the radionuclide which are only poorly or not at all visible in the normal scintigram. (tr-auth)

30051 COMMISSURE-CROSS HINGED RADIUM APPLICATOR (AUTOMATIC FUNDUS HYSTEROSTAT). F. G. Granone and G. Juliani (Universita, Turin). Radiol. Med., 61: 283-9(Mar. 1965). (In Italian)

A new radium applicator for endocavitary radiotherapy is described. When closed, the instrument resembles a Hegar no. 10 dilator; opened to the utmost it assumes a commissure-cross shape. The hinge and locking of the short arm are easily adjustable in all positions. This applicator is particularly indicated for radium treatment of the fundus in carcinoma of the endometrium and is equally useful for the irradiation of the rectum, vagina, or rhinopharynx. (tr-auth)

30052 ON THE THERAPEUTICALLY EFFICACIOUS DEPTH IN 200 kv ROENTGENTHERAPY ESTIMATED IN TERMS OF THE BIODOSE. BIODOSE TABLE. F. Bistolfi (Universita, Genoa). Radiol. Med., 61: 290-304(Mar. 1965). (In Italian)

The half value layer and half value tissue layer parameters useful in defining the penetration of a beam of photons do not indicate its therapeutic possibilities. A new physical-biological parameter defined by the author, the therapeutically efficacious depth, accomplishes this task. (tr-auth)

30053 PROTECTION AGAINST RADIATION IN OBSTETRIC RADIOLOGY. Marcelo H. Moreau (Hospital T. Alvarez, Buenos Aires). Rev. Asoc. Med. Arg., 78: 510-12 (Sept. 1964). (In Spanish)

After a discussion of the hazards of diagnostic radiation procedures in pregnancy, from the point of view of possible fetal injury, some factors for reducing the fetal dose are considered. The principal dose-reduction factors are distance, kilovoltage, and filtration, when these are varied appropriately. Another factor which is usually not considered is the position of the fetus, as determined by the position of the mother during radiography. Thus the absorbed radiation dose of the fetus is greater, using the standard radiography condition of 3 mm Al filtration with 100-kv x rays, in the usual ventrodorsal direction of the beam than in the dorsoventral position. That is, the fetus receives more exposure in comparable radiographs when the pregnant patient's abdomen is facing the x-ray tube than when the patient's back is facing the tube. Some depth doses were measured in paraffin blocks, using 100-kv unfiltered x rays, to estimate roughly the differences in fetal exposures in these two positions. It was estimated that with the pregnant patient lying on her back, facing the x-ray tube, the midplane of the fetus is at an average tissue depth of 10 cm, whereas when she is lying on her abdomen, the effective tissue depth is 20 cm, a two-fold increase in this value. Thus in the dorsoventral position, maternal tissue provides added filtration to the beam passing through the fetus. It was calculated for a maternal abdominal anterio-posterior distance of 30 cm, the fetus would receive >5 times as much radiation from 100-kv radiography in the ventrodorsal as compared with the dorsoventral position. Thus the total absorbed fetal dose would be ~22 and 4% of the skin dose, respectively, in the two positions. It is therefore concluded that in diagnostic radiology during pregnancy an appreciable protective factor to the fetus can be obtained by having the pregnant patient lying on her abdomen under the x-ray source. (BBB)

30054 THE USE OF BETA RAYS IN OPHTHALMOLOGY. M. Quintana and Jose L. Menezo (Clinica Universitaria de Oftalmologia, Barcelona). Rev. Espan. Oto-neuro-oftalmol. Neurocir., 22: 126-44(Mar.-Apr. 1963). (In Spanish)

Various forms of ionizing radiations which may be used for irradiation of the eye are considered, with emphasis on the necessity of protecting other facial structures and especially the brain from radiation injury. Reasons are presented for the conclusion that β radiation, because of its short range, is most useful for irradiating diseased portions of optic tissue without injuring deeper or surrounding tissues. Soft x rays (8 to 12 kv) can be used in ophthalmology, but here the problem is limiting the area exposed. Gamma rays, such as obtained with Ra, are too penetrating. However, Ra D which emits almost pure β radiation (0.34 and 1.17 Mev) is useful for irradiation of the eye, and ^{90}Sr provides another useful source of β rays. Various types of applicators for use with these two isotopes, and dosimetry aspects of their use are discussed. Applications of β radiation in opthalmology are outlined. β irradiation in doses of 3000 to 10,000 R can be used for vascularized corneal lesions which follow keratoplasty, the intense local irradiation being used to obliterate the small blood vessels in these lesions. β irradiation-keratectomy can be used in cases of recurrent corneal vascularization, usually in 3000-R doses, combined with steroid-antibiotic therapy. Use of β radiation, with specified doses and techniques, in the following conditions is also outlined: before and after keratoplasty, corneal ulceration, rosaceous keratitis, pterygium, chronic sclerokeratitis, interstitial keratitis, corneal scars, conjunctival hemangiomas, epithelial invasion of the anterior chamber, and epithelioma. Effects of radiation on opthalmologic tissues and complications of radiotherapy of the eye are also considered, with reference to the authors' cases and reports in the literature. Usually, weekly β-ray doses of 3000 rep, up to a total of 11,000 rep in three to five weeks is sufficient for corneal lesions, without causing injury to other eye structures, if treatments are given for three min each

session by direct application of ^{90}Sr or for five min per session with the applicator at a distance of one mm. Complications in the lens, sclera, conjunctiva, and cornea are described. Ten of the authors' cases treated with Ra D-E (20 mC) are examined in detail. (BBB)

30055 A CASE OF UTERINE CANCER WITH SEVERE BONE METASTASIS TREATED BY TELECOBALT RADIOTHERAPY. Otomasa Ito and Atsuhiko Furuta (Tokyo Teishin Hospital). Rinsho Hoshasen, 9: 194-7(Mar. 1964). (In Japanese)

The case of a 57-year-old woman with cervical cancer and pelvic metastases is reported. Telecobalt therapy was applied to the uterine cervix for 38 days and for 46 days. The cervical cancer regarded as the primary lesion was completely cured, and the pelvic metastatic lesion had not recurred two years after treatment. It is concluded that the ^{60}Co γ-irradiation, as compared with the x irradiation, does not cause bone necrosis and provokes very little skin reaction. (H.G.D.)

30056 GENERAL NOTES ON THE PHYSICS OF IONIZING RADIATION. G. D'Ambrosio. Riv. Med. Aeron. Spaziale, 27: 505-17(Oct.-Dec. 1964). (In Italian)

The physics of ionizing radiation are briefly considered from the medical viewpoint. The interaction of corpuscular radiation with matter, the penetrating capacity into tissues, specific ionization, and units for the measurement for ionizing radiation are summarized. The biological effects are considered. (J.S.R.)

30057 CONCERNING A NEW ADJUSTABLE OVARIAN SHIELD FOR X-RAY PHOTOGRAPHY OF THE PELVIS. H. Buechner and G. Wendrich (Chirurgische Universitatsklinik, Erlangen, Ger.). Roentgen Bl., 16: 385-94(Dec. 1963). (In German)

An adjustable shield for protecting the ovary from x irradiation has been designed for use when taking photographs in children. The shield can be increased or reduced in size, so that it is independent of the age of the patient. It can be used even if the position of the ovaries cannot be definitely established from anatomical landmarks. Three basic sizes are sufficient for all ages. The shields have a Pb equivalent of 0.8 mm, and have a washable plastic covering. The most important feature of these shields is the adjustable butt straps which permit exact positioning of the shield. It is known that the ratio between the distantia spinarum and the internal maximum transverse pelvic measure is about 2:1. Taking the magnification that the x rays undergo into account, the straps are adjusted so that they form a straight line between the spinae ilicae superiores. The shield rests in a cranio-caudal direction so that the symphysis and pubis are not covered, and the hip can move freely in the lateral direction. Exact positioning is not required. Small deviations will not cause improper diagnosis, and if the shield used is too small, the dose is reduced to at most 38% of the unshielded value, as shown by studies on phantoms. (BBB)

30058 THE DIFFERENTIAL DIAGNOSIS OF HEMATOLOGICAL DISORDERS WITH ISOTOPE METHODS. H. E. Brunner (Universitat, Zurich). Schweiz. Med. Wochschr., 95: 285-96(Feb. 1965). (In German)

Isotope methods currently available in the laboratory of a major hospital for the routine diagnosis of hematological disorders are reviewed. Radioactive ^{51}Cr is used to determine erythrocyte survival and to localize the site of destruction of red blood cells in hemolytic anemias (erythrokinetic studies). Radioactive ^{59}Fe permits assessment of erythrocyte production and or iron distribution in the body (ferrokinetic studies). The blood volume can be determined in the course of either erythrokinetic or ferrokinetic studies, and the two methods can be performed simultaneously. They are of particular value in differentiating the various types of anemia, polycythemia, and iron-storage diseases. The vitamin B_{12} absorption test with radioactive ^{58}Co-labeled-vitamin permits clear-cut differentiation of the various causes of megaloblastic and macrocytic anemias. The performance of cytokinetic studies with ^{3}H-thymidine and investigations with ^{3}H-folic acid is still restricted to specialized laboratories. (auth)

30059 NUCLEAR MEDICINE IN THE IAEA. H. Vetter (International Atomic Energy Agency, Vienna). Wien. Z. Inn. Med. Grenzg., 45: 228-41(1964). (In German)

The development of nuclear medicine is briefly reviewed. The series of methods available to the IAEA for the promotion of the use of radioisotopes in medicine is described. These include scholarships and courses, experts and instruments, research commissions, information exchange, and some scientific studies. (J.S.R.)

30060 EXPERIMENTAL AND CLINICAL STUDIES OF KIDNEY FUNCTION USING RADIOISOTOPES. K. Zum Winkel. Thesis, Heidelberg, Universitat, 1962. 214p. (In German). $2.00 (Gmelin, AED-DISS 62-722).

Results of experiments with 610 rats and 4 dogs indicate that I-131-hippuran is the best available substance for nephrography because it is excreted rapidly. Clinical results with this substance are discussed. (318 references.) (Gmelin Inst.)

30061 COMPARING DOSIMETRIC STUDIES OF VARIOUS METHODS OF HYPOPHYSIS IRRADIATION. (AN EXPERIMENTAL STUDY WITH CLINICAL DEMONSTRATIONS). H. Buttenberg. Thesis, Erfurt, Ger., Medizinische Akademie, 1963. 126p. (In German). $2.00 (Gmelin, AED-DISS. 63-747).

Dose distributions for pituitary hypophysis irradiations by various methods, as fixed and rotational irradiation, megavolt therapy, and radioisotope implantation were studied. It was concluded that maximal doses of hypophysis ablation or for therapy of low sensitivity tumors can be produced by 340 Mev protons or by implantation of ^{198}Au. (327 references.) (Gmelin Inst.)

30062 THE APPLICATION OF ^{51}Cr FOR DETERMINATION OF ERYTHROCYTE LIFETIME, ERYTHROCYTE SEQUESTRATION, AND SPLEEN SCINTIGRAPHY. J. Fischer. Thesis, Mainz, Universitat, 1963. 272p. (In German). $2.00(Gmelin, AED-DISS. 63-748).

Methods for determination of erythrocyte lifetime are reviewed. Examples of clinical applications of the ^{51}Cr method are given. Erythrocyte sequestration was investigated using a plastic phantom with exchangeable organs of various sizes. Spleen scintigraphy is a valuable tool for diagnosis of spleen changes which are not detectable by clinical methods. Average gonad dose was about 40 mrad. (382 references.) (Gmelin Inst.)

30063 RADIOISOTOPES AND CIRCULATION. Sevelius, Gunnar, ed. Boston, Little, Brown and Company, 1965. 323p. $13.00.

Information is included on: instrumentation for clinical studies; fundamentals of data interpretation; blood volume; regional blood volume measurements; diagnosis of pericardial effusion by radioisotope scanning; cardiac output; coronary blood flow; use of isotopes in the detection of cardiac shunts; brain circulation; use of radioisotopes in the study of gastric hemodynamics; portal circulation; liver blood flow; renal blood flow; and circulation in extremities. 366 references are cited. (P.C.H.)

30064 GAMMA-RAY IRRADIATION APPARATUS. Laszlo Bozoki, Istvan Martos, and Istvan Wein (to Medicor Rontgen Muvek). British Patent 987,884. Mar. 31, 1965. Filed Feb. 14, 1962.

A gamma irradiation apparatus includes two screened isotope containers separated and connected by a rigid radiation-screened tube. So as to facilitate safe radiation screening even when ^{60}Co or ^{137}Cs sources are used, one container is accommodated in the wall of the irradiation room and screened by the wall. The other container constitutes the irradiator head and is movable along an arc in such a manner that the radiation beam always passes through a selected point. Means are provided for moving the source from one container to the other and returning it by utilization of gravity. Since the source can be removed from the irradiator head, the device ensures protection for the physician or nurse during the positioning of the patient, and considerably reduces the weight of the irradiator head moving over the patient. Only the radiation protection necessary for the patient has to be on the irradiator head. (B.L.M.)

CHEMISTRY

General

30065 (LA-3291) ARCHPRO—A COMPUTER PROGRAM FOR THE COMPUTATION OF MOLECULAR WEIGHTS BY THE ARCHIBALD METHOD. G. R. Shepherd, P. N. Dean, and B. J. Noland (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Apr. 8, 1965. Contract W-7405-eng-36. 16p. Dep.; $1.00(cy), 1(mn) CFSTI.

A computer program (ARCHPRO) has been prepared in FORTRAN for computation of ultracentrifugal data obtained in the determination of molecular weights by the Archibald method. (auth)

30066 (ORNL-3789) REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1965. (Oak Ridge National Lab., Tenn.). Apr. 1965. Contract W-7405-eng-26. 372p. Dep.; $7.00 (cy), 6(mn) CFSTI.

Research progress is reported under 26 topics. Separate abstracts were prepared for each. (J.R.D.)

For abstracts of individual sections see: 30067, 30149, 30150, 30151, 30152, 30153, 30154, 30233, 30301, 30302, 30323, 30650, 30651, 30671, 30672, 30673, 30744, 30825, 30826, 30827, 30828, 31332, 31468, 31478, 31608, and 31609.

30067 (ORNL-3789(p.56-98)) CHEMICAL STUDIES OF MOLTEN SALTS. (Oak Ridge National Lab., Tenn.).

Continued studies of the chemistry and thermodynamics of molten fluorides are being made by the method of equilibrating the melts with gaseous HF and H_2O. Equilibrium measurements were made at 565 to 970°C of the reaction $UF_4 + \frac{1}{2}H_2 \rightleftharpoons UF_3 + HF$, with solid UF_4 and UF_3 and with these compounds dissolved in molten $LiF-BeF_2$ mixtures. Reduction of SO_4^{2-} in molten fluoride mixtures and subsequent removal of S as H_2S on sparging with H_2–HF mixtures was studied to improve S removal in the processing of MSRE fuels. Reference electrodes based on the Be/Be^{2+} and H_2, HF electrode reactions were found suitable for use in molten Li_2BeF_4. A method was deduced for interpreting the peak-shaped current-voltage curves obtained by linear voltage scan voltammetry of molten fluoride solutions. The method was verified by studies of the reductions of Fe(II) and Ni(II). A continuing study of the viscosity of the $LiF-BeF_2$ system is showing how viscosity changes with composition, how these changes are correlated with structural parameters of the individual components, and how this system compares with the analogous $MgO-SiO_2$ system. A method for estimating the density of molten fluoride mixtures in the laboratory was developed for use in inert-atmosphere glove box enclosures. It is based on measurement, of the height of a known weight of melted mixture in a cylinder. Studies of the vapor species given off from an $LiF-BeF_2$ (66-34 mole %) near its liquidus temperature were made by the use of a time-of-flight mass spectrometer. The results suggested that BeF_2 was the dominant species evolved from the molten state. Vacuum distillation of simulated MSRE fuel salt afforded essentially complete recovery of the carrier salt and recovery of about 80% of the UF_4 with an overall separation factor in excess of 50 from EuF_3 used to simulate rare earth fission products. The separation was done in an INOR-8 still, by single-pass distillation, with heat supplied by an ordinary vertical tube furnace. Gas transport properties of an impregnated graphite (CGB grade) chosen for use in the MSRE were evaluated and compared with those for other reactor and commercial graphites. Removal of ^{135}Xe from the MSRE by stripping of gas from fluid flowing at a low rate through the pump bowl was reestimated. Results indicate that Xe poisoning will be a considerable problem in the reactor. Prompt removal of Pa from irradiated Th would minimize neutron losses to ^{233}Pa and permit production of isotopically pure ^{233}U. Such a prompt removal requires a mobile Th-bearing blanket as well as an associated Pa-separation process. A brief study of this system was made to assess its usefulness as a special mobile blanket. (J.R.D.)

30068 (WAPD-T-1801) SINGULAR PERTURBATIONS OF BOUNDARY VALUE PROBLEMS ARISING IN THE STUDY OF CHEMICAL REACTORS (thesis). Louis Barton Freeman (Pittsburgh Univ., Pa.). 1965. Contract AT(11-1)-Gen-14. 218p. Dep.(mn); $6.00(cy), 4(mn) CFSTI.

The boundary value problem for the steady-state concentration of a single substance in dilute solution in a chemical flow reactor is considered. Closed-form approximate solutions are constructed for the nonlinear cases, using boundary layer methods. The domain is divided into two subdomains, and a simplified problem is solved in each subdomain. The closed-form solutions are compared to available numerical solutions; the agreement is good. Extensions of the solutions to the problems for a single substance and for N substances are discussed. (D.L.C.)

Analytical Procedures

Refer also to abstracts 30196, 30629, and 30630.

30069 (AAEC/TM-289) INCREASED SENSITIVITY IN X-RAY FLUORESCENCE ANALYSIS USING FILTERED EXCITING RADIATION. K. P. Champion and R. N. Whittem (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr. 1965. 11p. Dep.(mn).

The use of filters in the primary beam of an x-ray spectrometer is suggested as a method of increasing sensitivity of detection. A theoretical and experimental treatment of the case of strontium aqueous solution has been made. Results show a considerable improvement in detection limit in some circumstances, and a marginal improvement in others. (auth)

30070 (AD-611006) A GENERAL SPECTROCHEMICAL METHOD FOR THE DETERMINATION OF IMPURITIES IN HfO_2, TiO_2, AND ZrO_2. James H. Muntz (Air Force Materials Lab., Wright–Patterson AFB, Ohio). Dec. 1964. 29p. (AFML-TR-64-357). $2.00(CFSTI).

The need for the analysis of many types of refractory materials made it desirable to have one method that would be applicable to as many of these materials as possible. The method developed provides identical conditions for sample preparation, excitation, and other steps in the analysis of HfO_2, TiO_2, and ZrO_2 and compounds or materials that can be converted to the oxides. The technique involves the use of a mixed buffer-carrier, a controlled atmosphere, relatively high amperage, and a short exposure time. Conditions were selected to give optimum sensitivity for impurities with minimum spectral interference from the matrix. Determination of some of the refractory impurities such as Hf in ZrO_2, as well as the more volatile impurities is possible. Sixteen impurity elements can be determined, most of them in the 10–1000 ppm range, with an overall precision of about ±20%. Two additional impurity elements are determined semi-quantitatively by visual estimation. (auth)

30071 (AERE-AM-100) THE DETERMINATION OF CERTAIN ARTIFICIAL AND NATURAL RADIOACTIVITIES IN RAIN WATER. Wallace, C. G. (Research Group, United Kingdom Atomic Energy Authority, Woolwich Outstation (England)). Jan. 1965. 42p. Dep.; $1.20(BIS).

Procedures are described for the determination in rain water of strontium-89 and 90, cesium-137, cerium-141 and 144, barium-140, and of the naturally occurring radionuclides lead-210 (RaD), polonium-210 (RaF), and beryllium-7. (auth)

30072 (AERE-R-4906) THE ANALYSIS OF URANIUM PHOSPHIDES. G. W. C. Milner, D. H. Rowe, and G. Phillips (Atomic Energy Research Establishment, Harwell (England)). Apr. 1965. 18p. Dep.; $0.60(BIS), 3s.(HMSO).

Methods are described for the chemical analysis of uranium monophosphide (UP) and a higher phosphide (U_3P_4) produced as an intermediate in the preparation of the monophosphide. Sintering with a 3:1 mixture of sodium peroxide and sodium carbonate in a nickel crucible at 350°C for 1 hour is employed to dissolve samples for the determination of the phosphorus content. After extracting the sinter with water and adjusting to between 0.5 and 0.8 M in HNO_3, the solution is passed through a column of cation exchanger (Zeocarb 225) to remove uranium. The phosphorus content is then determined by precipitation as ammonium phosphomolybdate, followed by filtration, drying at 280°C, and weighing. A slight correction is necessary to allow for a negative bias of 0.1% in the method. The precision of a determination is <0.2% (coefficient of variation). For the determination of uranium, a separate sample is taken and dissolved in HNO_3 + HCl. After adjusting to pH 4.5, the uranium is precipitated as uranyl ammonium phosphate by adding ammonium hydrogen phosphate and boiling. The precipitate is filtered, ignited to uranyl pyrophosphate and weighed. Results are quantitative for this determination with a coefficient of variation of 0.24%. (auth)

30073 (CEA-R-2729) ETUDE DE LA PURETE DU ZIRCONIUM ET DU NIOBIUM AU COURS D'UNE SEPARATION CHIMIQUE MESURE DES ISOTOPES DE LA CHAINE 95. (Study of Zirconium and Niobium Purities during a Chemical Separation — Measurement of the Isotopes of the 95 Chain). Pierre Simonet and Genevieve Simonet (Commissariat à l'Energie Atomique, Saclay (France). Centre d'Études Nucléaires). Mar. 1965. 50p. Dep.(mn).

This study is done by γ spectrometry; when ^{95}Zr is contaminated by ^{95}Nb or reciprocally, their measurement becomes difficult because of the weak difference between γ-ray energies. Proportions of ^{95}Zr and ^{95}Nb may be obtained quickly, whatever the age of the mixture, by a graphical method. The stabilizer of drift improves security in accuracy of results. In case of separation of ^{95}Zr and ^{95}Nb from two different phases, partition coefficients may be determined by measuring the evolution of ^{95m}Nb formed using the 17-kev x ray; comparison with a theoretical curve representing the formation of ^{95m}Nb permits a great accuracy. During this study, some nuclear constants which were insufficiently known were determined. (auth)

30074 (EUR-1819.e) ON ELECTRON MICROPROBE ANALYSIS. QUANTITATIVE AND STRUCTURAL ANALYSIS OF NUCLEAR MATERIALS. Proceedings of the International Symposium, held in Ispra, Italy, October 7-9, 1963. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 225p. (CONF-631003)

In English and French.

Sixteen papers are presented on the following topics: analysis of light elements, trace determination, diffusion in U–V–Si–Al, iron meteorites, coated-particle fuels, corrosion, SAP and Al, and sample preparation. Separate abstracts were prepared for eleven of the papers. (D.L.C.)

For abstracts of individual papers see: 30075, 30076, 30077, 30078, 30645, 30731, 30732, 30733, 30734, 30735, and 30910.

30075 (EUR-1819.e(p.1-14)) SCANNING MICROANALYSIS OF LOW ATOMIC NUMBER ELEMENTS IN METALS. G. V. T. Ranzetta and V. D. Scott (Atomic Weapons Research Establishment, Aldermaston (England)).

The difficulties of detecting light elements in the presence of heavier elements are noted. An apparatus using a proportional counter to detect the soft x rays and a network of pulse-height analyzers and ratemeters to separate the signals from the elements, is described. Results of scanning experiments of Be, Fe, and U with C, O, and N and of contamination buildup experiments are described. (D.L.C.)

30076 (EUR-1819.e(p.15-23)) QUANTITATIVE MICROANALYSIS OF LOW ATOMIC NUMBER ELEMENTS. G. V. T. Ranzetta and V. D. Scott (Atomic Weapons Research Establishment, Aldermaston (England)).

X-ray and electron absorption effects are large for light element systems. Measurements using the network unit at 1 to 20 kv were made on silicon carbide, iron carbide, and uranium carbide. The experimental results were compared with proposed corrections, and it was found that the correction of Mulvey and Archard agrees well with the results over the entire voltage range. The factors influencing the accuracy of determinations are discussed. (D.L.C.)

30077 (EUR-1819.e(p.27-36)) CALCULATION OF THE DETECTION THRESHOLD AND THE DETECTION LIMIT IN ELECTRON MICROPROBE ANALYSIS. K. Taeffner and R. Theisen (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

The statistical theory of the detection threshold and detection limit is discussed, and calculations are made using probability theory. The optimum operating conditions for low concentrations are discussed, and some of the problems of long measurements are considered. Experiments on Ti diffusion in Magnox and on bonding of SAP by Ag diffusion are described. (D.L.C.)

30078 (EUR-1819.e(p.171-85)) MICROANALYSIS OF PLUTONIUM–URANIUM CERAMIC MATERIALS. G. V. T. Ranzetta and V. D. Scott (Atomic Weapons Research Establishment, Aldermaston (England)).

The determination of Pu distribution in ceramic fuels is of considerable importance, and an appraisal is given of the potentialities of the electron-probe microanalysis method in this field. Some examples are given of segregation in mixed U–Pu oxide and carbide ceramics. (D.L.C.)

30079 (MSAR-65-58) DEVELOPMENT OF TECHNIQUE FOR MEASUREMENT OF IMPURITIES IN SODIUM. Progress Report 56-1, April 1965. (MSA Research Corp., Callery, Pa.). May 14, 1965. Contract AT(11-1)-765. 15p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The following techniques are being evaluated for the determination of C, O, and H contaminants in sodium: (1) laboratory techniques: high-temperature mass spectrometry, magnetic effects, surface tension, organic solvent extraction; (2) in-stream techniques: physical property change due to carburization, electrical sensing of particles, electrical potential concentration of sodium oxide, and continuous hydrogen monitoring. (D.L.C.)

30080 (NAA-SR-9600(Vol. III) NONDESTRUCTIVE DETERMINATION OF U^{235} CONTENT OF SNAP FUEL RODS. VOL. III. EQUIPMENT DESCRIPTION AND PRODUCTION QUALITY CONTROL APPLICATIONS. A. R. Mooers and R. C. Barry (Atomics International, Canoga Park, Calif.). May 15, 1965. Contract AT-11-1-GEN-8. 28p. Dep.; $2.00(cy), 1(mn) CFSTI.

An autoradiometric test method and associated production inspection equipment have been developed for nondestructively measuring the incremental and total ^{235}U content in cylindrical SNAP fuel rods. The determination is accomplished by measuring the intensity of the 185-kev gamma photo peak from ^{235}U and comparing this value with a reference standard of known composition. A prototype single-channel analyzer scintillation counting system and special fuel rod scanning mechanism are described. A statistical evaluation of the autoradiometric and destructive chemical methods disclosed a correlation coefficient between the two methods to be 0.976. The precision of the autoradiometric method was 0.023 wt % uranium when the test samples were fully enriched 10% U-Zr SNAP fuel rods. (auth)

30081 (NBL-216) SEMIANNUAL PROGRESS REPORT FOR THE PERIOD JANUARY 1964 THROUGH JUNE 1964. (New Brunswick Lab. (AEC), N. J.). Mar. 1965. 107p. Dep.; $4.00(cy), 3(mn) CFSTI.

A fusion-cation exchange method for converting B samples to sodium tetraborate for B isotopic analysis was developed. The ^{10}B recovery from scrap materials is continuing with about 83 kg of potassium fluoborate having been prepared. A discussion is presented of TID-7029. Experimental results show that the cup-dia. dimension

has an effect on the analytical results obtained by carrier-distillation procedures. A rapid gamma counting method for the determination of U at 0.001 to 0.5% in rocks and soils was demonstrated. Comparative data were obtained showing the relative counting characteristics for ^{16}N activity by NaI scintillation counting and two modes of Cherenkov counting. A method utilizing the suppression of U neutron activation in determination of ^{10}B in B materials was developed. The linearity of high megohm resistors used in conjunction with a Cary Model 31 vibrating reed electrometer was determined. Resistors ranging from 10^{10} to 10^{12} ohms are linear to within 0.9% below currents of 1×10^{-12} amperes and to within 0.2% for larger currents. A comparison of data between 60 and 90° mass spectrometers is presented. The instrumentation and calibration of a tandem 90° sector mass spectrometer are described. A procedure for mass spectrometric determination of isotopic and total U–Pu concentration by isotopic dilution is described. A method for separation of Pu and U in irradiated fuel element solutions by anion exchange is described for isotopic analysis and total element determination. A hydrostatic weighing technique using xylene as immersing liquid was employed for density measurements on Pu metal in order to obtain an accuracy of about 0.1 to 0.5%. The precision and accuracy of weighings made with semi-micro balances in gloved boxes were compared with those obtained under the usual laboratory conditions. The precision of weighings (95% confidence limits) was found to be 0.00011 g for gloved box work and 0.00003 g for conventional operations. The sensitivity for the determination of B in Pu and U was increased making it possible to reduce the concentration range from the 1 to 30-μg level to 0.1 μg of B using U as a substitute for Pu. Observations on the use of diphenylamine sulfonate indicator in potassium dichromate titrations are included. (J.R.D.)

30082 (NP-14969) A FEASIBILITY STUDY OF THE METHOD OF NON-DESTRUCTIVE ASSAY OF U-235 AND Pu-239 IN IRRADIATED FUEL SLUG. (Atomic Energy Establishmen:, Trombay (India). Nuclear Physics Div.). [nd]. 79p. Dep.(mn).

A new approach to the problem of non-destructive assay of fissile material is discussed. It is shown that by using a slowing-down-time lead spectrometer and making use of the difference in fission cross section of ^{235}U and ^{239}Pu in the 0.1 ev to 1 ev region, it is possible to estimate their concentration in case of unirradiated samples. Because of the lack of an intense neutron source, the method could not be applied to the case of an irradiated sample. However, from the data obtained with the plutonium sources, a method of analysis that could be followed in the case of irradiated samples is outlined. As the main energy region of interest is below 1 ev, where chemical binding and thermal motion of the atoms of the moderator play part on the slowing-down time and dispersion of the neutron spectrum, it is imperative that experiments to investigate these effects should be undertaken. Similar experiments using selective absorbers such as Cd to narrow the neutron dispersion at low energies so as to improve the accuracy of the analysis by achieving maximum cross-section at resonance energy should be performed. More experiments that could be undertaken to furnish information, are indicated. (auth)

30083 (ORNL-P-1237) RADIOACTIVATION ANALYSIS AS AN ANALYTICAL TOOL. W. S. Lyon (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 25p. (CONF-650521-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Conference on Purification of Materials, New York.

A survey is presented of the characteristics of activation analysis. Possible interferences and errors are discussed, taking the determination of cobalt as an example. Nondestructive activation analysis using gamma-ray spectrometry is next considered. The decay schemes and gamma spectra of ^{60}Co and ^{60m}Co are described, and the application of computer techniques to data handling is discussed. Finally, non-reactor neutron sources and non-neutron activation analysis are considered. (D.L.C.)

30084 (RL-SA-33) QUANTITATIVE DETERMINATION OF PLUTONIUM OXIDATION STATES IN VARIABLE NITRIC ACID SOLUTIONS FOR CONTROL LABORATORIES—SPECTROPHOTOMETRIC. Curtis A. Colvin (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). May 4, 1965. Contract AT(45-1)-1350. 8p. (CONF-650613-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Chemical Society, 20th Northwest Regional Meeting, Corvallis, Ore.

Methods and data are presented which provide a rapid quantitative determination of plutonium oxidation states in variable nitric acid solutions. Experience concerning practical use of a recording spectrophotometer when working with plutonium solutions is given. The following are lower limits when using 1-cm absorption cells: Plutonium (VI)–0.01 g/l; Plutonium(IV)–0.1 g/l; Plutonium(III)–0.2 g/l. The absorptivities of various plutonium ion absorption peaks in 2.0 M HNO_3 solutions are given. These values should be used only as approximations in individual instrumental systems, since each spectrophotometer should be calibrated in order to obtain maximum accuracy. Factors are presented which when applied to the peak absorptivity at 2.0 M HNO_3 will yield the absorptivity at the listed HNO_3 molarity. These factors may be used with any spectrophotometer. Formulas are given which will allow quantitative calculations of each oxidation state of plutonium. (auth)

30085 (TID-21853) ION EXCHANGE SEPARATION OF URANIUM AND THORIUM IN NON-AQUEOUS AND MIXED MEDIA. Progress Report, October 1964–April 1965. Johann Korkisch (Vienna Univ. (Austria). Analytisches Institut). Apr. 1965. Contract AT(30-1)-2623. 34p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A fluorimetric method for determination of U in sea water and other geological samples is described. Ion exchange is used to separate U from interfering elements on Dowex 1 in 90% methyl glycol and 10% 6 N HCl. Determinations of U can be made in 250 ml of sea water or in 0.1-g solid samples. The behavior of U, Fe, Ga, and Co towards the anion exchanger Dowex 1, X8 was investigated in organic solvent-HBr mixtures. From 90% methanol–10% 4.5 N HBr, Ga, In, Zn, Cd, Pb, Bi, and Cu are retained by the resin, and Fe, Al, U, Co, and the alkaline earth metals pass into the effluent. Elution with 90% water–10% 4.5 N HBr removes Ga, In, and Zn thus separating them from Cd, Pb, Bi, and Cu which are absorbed on the resin. To avoid formation of Br and to ensure that all Fe is in the divalent oxidation state, excess of ascorbic acid is added to all solvent-hydrobromic acid mixtures. A method of separation of small quantities of U from large excess of Bi is described. In 90% isopropanol–10% 6 N HCl, U(IV) is retained on Dowex 50 whereas Bi as anionic chloride complex passes into the effluent unadsorbed. For the elution of U, 12 N HCl is employed. The method can be used for determination of U in Bi in the Mg range. Other metal ions such as Mo, Zn, Cd, and In can be separated from U. (J.R.D.)

30086 (Y-1481) SPARK-SOURCE MASS SPECTROMETRIC ANALYSIS OF COMMON AND RADIOGENIC LEAD. J. C. Franklin and E. B. Griffin (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Feb. 25, 1965. Contract W-7405-eng-26. 10p. Dep.; $1.00(cy), 1(mn) CFSTI.

Spark-source mass spectrography was utilized to provide a method of analysis that is fast and has extremely low levels of detection for more than forty elements that may be present in lead. (auth)

30087 (IS-Trans-15) ADVANCES IN THE SPECTROCHEMICAL ANALYSES OF THE NON-METALS WITH POWERFUL LOW-VOLTAGE SPARKS. K. Pfeilsticker. Translated by S. K. Myers (Ames Lab., Iowa State Univ. of Science and Tech.), from Mikrochim. Acta, 358-[75](1955). 22p. Dep.(mn); $2.60(fs), $0.86(mf) JCL.

An improvement is made in the spectrochemical detection of non-metals with high-current low-voltage sparks. It was found possible to raise the detection sensitivity particularly by also lowering the self induction. Details of the apparatus were better constructed. Sulfur and halogens (except fluorine) can be detected down to quantities below

1 μg; the fluorine lines become visible at 10 μg. It is easy to show the presence of argon in the air. The sulfur is readily detected in noble metals damaged by sulfur, and this element is distinctly revealed in steels down to 0.02% or less. Fundamentally, the determination of hydrogen in metals has been proved possible by earlier experiments. The conditions are stated and a discussion of the opposing demands of excitation and volatilization is included. Several theoretical remarks about low-voltage sparks are given. (auth)

30088 (JPRS-30087(p.45-9) RING OVEN TECHNIQUE FOR THE ISOLATION AND DETECTION OF THORIUM AND ZIRCONIUM. Shih-nien Shen, Hsin-tu Keng, and Ting-hsueh K'ang. Translated from Hua Hsueh Tung Pao, No. 3, 59-60(Mar. 1965).

A ring oven technique using meta-hydroxybenzoic acid is given for separating Th and Zr on a filter paper. After the filter paper containing the hydroxybenzoic acid and metal ions in a spot has been prepared, it is placed on a ring oven, and 0.02 and 0.2 N HNO_3 solutions are used to wash Th from the spot. Reagents are then used to identify Th and Zr. Experiments show that 0.1 to 500 μg Zr can be separated from 0.2 to 5 μg Th, and that the smallest amounts of Zr and Th which can be isolated are 0.1 and 0.2 μg, respectively. (D.L.C.)

30089 (JPRS-30087(p.52-60)) THE STUDY OF THE METHOD OF THE γ SPECTRUM FOR THE ANALYSIS OF LOW URANIUM-, THORIUM-CONTAINING SUBSTANCES. Hsia Ming, P'u-huo Tsung, and Shu-pen Wu. Translated from K'o Hsueh T'ung Pao, No. 3, 259-61(Mar. 1965).

A comparison is made of seven programs in the high- and low-energy regions for the gamma spectral analysis of U and Th. The influence of the effective atomic number of the sample and of the U/Th ratio on analytical results are studied. It is concluded that the fourth low-energy program is the best program. (D.L.C.)

30090 GAMMA-RAY SPECTROMETRIC ANALYSIS OF THE CONCENTRATIONS OF Cr, Ag, Fe, Co, Rb, AND Pt IN NORMAL HUMAN ENAMEL. Rune Soeremark and Max Lundberg (Univ. of Umea, Sweden). Acta Odontol. Scand., 22: 255-9(June 1964).

Thermal neutron activation was used in combination with γ-ray spectrometric analysis to analyze 15 intact first bicuspids from humans between 14 and 16 years old. The teeth were extracted for orthodontic reasons and were prepared for activation with 48 hr after being extracted. These teeth had no restorations, and no fillings were present in the neighboring teeth. Nearly all of the enamel was separated from the dentin. Standards and the samples were irradiated in an aluminum can in a neutron reactor by thermal neutron beams for six days. The neutron flux was about 6.5×10^{13} neutrons cm^{-2} sec^{-1}. After irradiation and when a period of two months for decay of short-lived nuclides had elapsed, the samples were dissolved in N HCl to which 0.3% H_2O_2 was added. Activity was measured in a 3 × 3 in. well-type scintillation NaI (Tl) crystal in combination with a 256-channel γ spectrometer. The mean concentrations of the elements in enamel were (as ppM, dry wt): Rb 4.90, Cr 0.0037, Ag 0.0049, Fe 338, Co 0.00024, and Pt 0.0. No significant difference was found with respect to sex, nor between the teeth from upper and lower jaws. (BBB)

30091 AN AUTOMATIC ZONAL SCRAPER AND SAMPLE COLLECTOR FOR RADIOASSAY OF THIN-LAYER CHROMATOGRAMS. Fred Snyder and Harry Kimble (Oak Ridge Inst. of Nuclear Studies, Tenn.). Anal. Biochem., 11: 510-18(June 1965).

A completely automatic high resolution zonal scraper and sample collector was developed for removing quantitatively 1-, 2-, and 5-mm wide zones of adsorbent along a thin-layer chromatography (TLC) strip. Graphic representation of the radioactivity plotted as a continuum of adjacent zones along a chromatostrip provides an extremely sensitive radioindicator of contamination of commercially available labeled compounds and of closely related biological compounds chromatographed by TLC. Examples of zonal scans obtained with this instrument are illustrated for several samples of labeled (^{14}C, ^{3}H, ^{125}I, and ^{32}P) commercially available lipids. (P.C.H.)

30092 DETERMINATION OF ^{14}C RADIOACTIVITY IN BONES. Robert G. Kelly (American Cyanamid Co., Pearl River, N. Y.). Anal. Biochem., 11: 588-92(June 1965).

A method of analysis for ^{14}C activity in bone is presented. The method consists of an oxygen flask combustion of the tissue using a special combustion head that roasts the bone in an oxygen atmosphere. The $^{14}CO_2$ formed is then absorbed and determined by liquid scintillation. An analytical recovery of added radioactivity of 96.1 ± 7.9% was achieved. Comparison of this method with one that has been in use for some time on samples containing ^{14}C activity which was incorporated in vivo showed identical results from each procedure. The method should be applicable to the determination of several commonly employed isotopes in tissues that heretofore required more elaborate analytical procedures. (auth)

30093 CHEMICAL STRIPPING ANALYSIS. DETERMINATION OF CERIUM(IV), PERMANGANATE, AND IRON (III) IN THE MICROMOLAR CONCENTRATION RANGE. Stanley Bruckenstein and John W. Bixler (Univ. of Minnesota, Minneapolis). Anal. Chem., 37: 786-90(June 1965).

Oxidants such as Ce(IV) and MnO_4^- in 1N H_2SO_4, or Fe(III) in 1M HCl, will oxidize silver from a rotating platinum electrode. By depositing known amounts of silver on the electrode and determining the time variation of potential of the electrode, the time required to oxidize the silver can be determined. This time is inversely proportional to the concentration of oxidant in solution. The lower limits of applicability were Ce(IV) 10^{-6}M, MnO_4^- 5×10^{7}M, and Fe^{+3} 2×10^{-6}M. The oxidation of silver metal by these oxidants was found to be mass-transfer controlled. (auth)

30094 RADIOCHEMICAL DETERMINATION OF LEAD-210 AFTER SOLVENT EXTRACTION AS IODIDE AND DITHIZONATE. N. A. Talvitie and William J. Garcia (Dept. of Health, Education, and Welfare, Salt Lake City, Utah). Anal. Chem., 37: 851-4(June 1965).

^{210}Pb was determined radiochemically in environmental samples. Iron, zinc, tin, and similar heavy metals were removed by extraction of the thiocyanates with methyl isopropyl ketone. ^{210}Pb and stable lead were isolated by successive extractions as the iodide and dithizonate. The activity of the ^{210}Pb was determined by direct counting of its beta radiation or by counting the beta and alpha radiation resulting from ingrowth of ^{210}Bi and ^{210}Po. The recovery determined with standard ^{210}Pb was 95% with a relative standard deviation of 6.4% when ^{210}Po ingrowth was measured. (auth)

30095 MEASUREMENT OF LOW ENERGY BETA-EMITTERS IN AQUEOUS SOLUTION BY LIQUID SCINTILLATION COUNTING OF EMULSIONS. Michael S. Patterson and Ronald C. Greene (Veterans Administration Hospital and Duke Univ., Durham, N. C.). Anal. Chem., 37: 854-7(June 1965).

Triton X-100 was found to be an acceptable agent for the formation of stable emulsions of water and toluene for liquid scintillation counting. The properties of three counting mixes are described. These are: toluene: Triton, 2:1, which can be mixed with 23% water and give counting efficiencies of 10% for ^{3}H and 68% for ^{14}C; toluene: Triton: ethanol, 8:4:3, which can hold 43% water with counting efficiencies as high as 58% for ^{14}C; and toluene: Triton, 7:6, which forms a fluid emulsion with 43% water that sets to a rigid gel on cooling in which ^{14}C can be counted with 57% efficiency. (auth)

30096 GAS ANALYSIS BY GEIGER PULSE ATTENUATION. Frederick W. Williams and Arthur F. Findeis (Univ. of Alabama, University). Anal. Chem., 37: 857-61(June 1965).

Nucleonics counting gases possess electronic characteristics, which are markedly altered by the admixture of additional components. Alteration of the composition of the common counting gas, 1.3% butane-98.7% helium, results

in a change in gas amplification. The presence of all gases, except argon, investigated in this work, resulted in a decrease in the pulse amplitude when the counter was operated in the Geiger region of gas amplification. The decrease in pulse amplitude was a linear function of the amount of gas injected in the stream for many gases over wide ranges of sample injections. In most cases the pulse amplitude variations were additive. Linear calibration curves were obtained for many binary mixtures. In those cases where one of the components had a high electron attachment probability, nonlinear but reproducible data were obtained. The gases investigated were ammonia, nitrogen, oxygen, argon, ethylene oxide, carbon dioxide, hydrogen, sulfur dioxide, low-molecular-weight hydrocarbons, and binary mixtures of these gases. (auth)

30097 ADSORPTION OF IONS IN DILUTE AQUEOUS SOLUTIONS ON GLASS AND PLASTIC SURFACES. G. G. Eichholz, Ann E. Nagel, and R. B. Hughes (Georgia Inst. of Tech., Atlanta). Anal. Chem., 37: 863-8(June 1965).

The relative adsorption, on glass and plastic surfaces, of some ions in highly dilute solutions was studied to permit an estimate of the error introduced into the analysis of natural waters by pipet and beaker contamination. Radioactive isotopes, including ^{137}Cs, ^{90}Sr, ^{91}Y, ^{144}Ce, Ba–^{140}La, ^{95}Zr, ^{131}I, and Ru–^{106}Rh were employed in these measurements. The surfaces compared included borosilicate glass and polypropylene beaker material and glass microscope slides. The effects of pH level and carrier concentration, particularly in hard waters, were investigated in detail, as well as several procedures for pretreating or coating the surfaces. The results indicated that, for most of the elements studied, it is preferable to use borosilicate glassware rather than polypropylene. Cesium, ruthenium, and zirconium in solution showed less contamination in polypropylene beakers. The total adsorption losses were small, except for yttrium and the rare earths, where some correction for contamination losses may have to be made in trace analyses. (auth)

30098 CHELOMETRIC DETERMINATION OF RARE EARTHS IN PRESENCE OF ALUMINUM. O. I. Milner and S. J. Gedansky (Socony Mobil Oil Co., Paulsboro, N. J.). Anal. Chem., 37: 931-3(June 1965).

A method was developed for determination of rare earths in the presence of a large excess of aluminum. Diethylenetrinitrilopentaacetic acid was the titrant and Xylenol Orange was the indicator. The aluminum was masked with 2,4-pentanedione. (M.C.G.)

30099 DETERMINATION OF SILICA IN GLASSES, CERAMICS AND REFRACTORIES. Yao-sin Su, D. E. Campbell, and J. P. Williams (Corning Glass Works, Corning, N. Y.). Anal. Chim. Acta, 32: 559-67(June 1965).

A rapid method for the determination of silica in glasses, glass ceramics, and refractories is described. The utilization of direct coulometric titration of the excess of 8-quinolinol employed to precipitate the silico-12-molybdate complex, enables duplicate determinations in the presence of diverse ions to be completed in about 3 hr. Studies of the optimum conditions indicated that the acidity and choice of acid were critical. For greatest versatility a sulfuric acid medium was better than hydrochloric or perchloric acids. The addition of glycerol allowed analysis of titanium-containing refractories. The accuracy of the method for a wide variety of materials is similar to that of the conventional acid-dehydration method. (auth)

30100 ISONITROSOACETANILIDE AS AN ANALYTICAL REAGENT. F. Buscarons and F. Buscarons, Jr. (Universidad de Barcelona). Anal. Chim. Acta, 32: 568-74(June 1965).

In studies on the reactivity of various isonitrosoacetarylides, the simplest of the series, isonitrosoacetanilide was examined. In acidic medium, this reagent gives a specific reaction with palladium (dilution limit I: 400,000), and in ammoniacal medium a very sensitive reaction with cobalt (dilution limit I: 1,000,000). The composition of the complexes involved was established as R_2Pd and R_3Co_2. The effect of substitution on the reactivity is discussed. (auth)

30101 DETERMINATION OF RADIOACTIVE ELEMENTS IN SANDS. I. AUTORADIOGRAPHIC STUDIES WITH PHOTONUCLEAR EMULSIONS. J. Casanova and C. Fernandez Carracedo (Universidad de Santiago de Chile). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 60: 249-54(Nov.-Dec. 1964). (In Spanish)

An autoradiographic technique to determine the concentration of alpha-emitting elements in Galician sands is presented. The quantitative results were in good agreement with chemical analyses. (auth)

30102 DETERMINATION OF RADIOACTIVE ELEMENTS IN SANDS. II. STUDIES OF RADIOACTIVITY OF INDIVIDUAL SAND GRAINS. J. Casanova and C. Fernandez Carracedo (Universidad de Santiago de Chile). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 60: 255-6(Nov.-Dec. 1964). (In Spanish)

An autoradiographic localization technique for determining alpha-emitting elements in the individual sand grains. The grains are absorbed in a photonuclear emulsion in gel form. To avoid the emulsion shrinkage the plates, after developing, are swelled with cellophane resin. (auth)

30103 DETERMINATION OF THE OXYGEN CONTENT OF STEEL WITH 14-Mev NEUTRONS. Hermann-Josef Kopineck, Gernot Sommerkorn, Rainer Bass, and Gunter Presser. Arch. Eisenhuettenw., 35: 987-91(Oct. 1964). (In German)

Previous results of nondestructive testing of semiproducts are discussed, and fundamental requirements for an operationally correct process are given. Nondestructive detection of oxygen was made by neutron irradiation. Gamma emission by oxygen was measured. The results of homogeneous and inhomogeneous partition of oxygen in steel are given. (Rev. Metal Lit., 22: No. 5, May 1965)

30104 ON THE IMPROVED MULTICOMPONENT RADIOMETRIC ANALYSIS. S. I. Babichenko, L. N. Krylov, and A. P. Utekhin. At. Energ. (USSR), 18: 426-8(Apr. 1965). (In Russian)

The results of γ-spectrum analysis $N = f(E)$ of uranium, radium, thorium, and potassium were used for estimating the stability of γ spectrometers. Studies were made of the construction principles of a high-stability amplitude pulse analyzer with differential channels and of the methods for improving the efficiency of radiometric analysis of multicomponent specimens. Differential γ spectra are given for uranium, U_3O_8, thorium, and potassium in a 15-kev channel with the level discrimination at 95 ± 3 kev. (R.V.J.)

30105 THE APPLICATION OF NEUTRON ACTIVATION CHROMATOGRAPHY TO THE DETERMINATION OF THE PURITY OF PHOSPHATE PREPARATIONS. Jiri Lustinec (Inst. of Biology, Czechoslovak Academy of Sciences, Prague). Biol. Plant., [Acad. Sci. Bohemoslov.,] 2: 67-9 (1959).

The activation of phosphorus on paper chromatograms was used to determine the purity of trade and laboratory organic phosphorus compounds. The sensitivity of the method was about 10 times better than the sensitivity of the color reaction. (M.C.G.)

30106 THE DISSOLUTION OF ZIRCONIUM IN HYDROFLUORIC ACID AND FLUOBORIC ACID. Toshio Sawada and Sakae Kato (Sumitomo Light Metal Industries, Ltd., Japan). Bunseki Kagaku, 14: 404-9(May 1965). (In Japanese)

The mechanism and the rate of dissolution of zirconium in hydrofluoric acid and in fluoboric acid at two temperatures of 9 and 100°C were studied for the purpose of effective dissolution of samples in various analytical procedures. In both systems, the rate of dissolution of zirconium is first-order with respect to hydrofluoric acid, and respective activation energies for the dissolution are 5.8 kcal ($9 \sim 100$°C). Evidence confirmed the same mechanism of the dissolution of zirconium in both systems. The difference between hydrofluoric acid and fluoboric acid on the

rate of dissolution of zirconium is understood from each magnitude of their HF concentration calculated from the acid ionization constant of hydrofluoric acid and the hydrolysis constant of fluoboric acid. A rather small effect of sulfuric acid on the dissolution of zirconium in both systems can also be deduced from the very small acid ionization of hydrofluoric acid together with the larger formation constant of fluoride complex of zirconium than that of its sulfate. It was concluded that mixtures of hydrofluoric- and sulfuric acid or of fluoboric- and sulfuric acid are probably useful as reagents for the complete dissolution of the samples of zirconium and zirconium-base alloys in many analytical procedures. (P.C.H.)

30107 APIGENIN AS A POSSIBLE REAGENT FOR THE DETERMINATION OF ALUMINUM IN PURE RARE EARTH MATERIALS. T. Nowicka-Jankowska and J. Minczewski (Inst. for Nuclear Research, Warsaw). Chem. Anal. (Warsaw), 10: 129-30(1965). (In Polish)

The difficulty of determining the presence of aluminum in rare earth materials with the use of a large variety of reagents arises from the interaction of these reagents with rare earths as well as with aluminum. This difficulty can be circumvented to a large extent with the use of Apigenin as a reagent. Studies of aluminum determination have been made in materials containing lanthanum, praseodymium, gadolinium, holmium, yttrium, and scandium in the range of pH 3 to pH 6. Scandium was found to interact with apigenin. Except for this singular problem, the method of aluminum detection appears to have an ultimate sensitivity of better than 0.01 micrograms Al/ml. This was determined from studies at pH 4. (TTT)

30108 REMARKS ON THE DISTRIBUTION OF RADIATING ATOMS IN ARC DISCHARGES. I. Rubeska (Central Geological Inst., Prague). Collection Czech. Chem. Commun., 30: 1292-7(Apr. 1965).

Using the image-spectrogram technique the distribution of the concentration of radiating atoms of Cs, Fe, In, Sr, and Zn in d-c as well as in a-c arcs under various conditions was studied. (auth)

30109 DETERMINATION OF LANTHANUM, PRASEODYMIUM, AND NEODYMIUM IN HIGH-PURITY CERIUM COMPOUNDS. Z. Radwan and B. Strzyzewska (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw). Collection Czech. Chem. Commun., 30: 1298-1302(Apr. 1965). (In German)

A method was developed for the spectroanalytical determination of lanthanum, neodymium, and praseodymium traces in cerium oxides. The method is suited for control of the purification processes of compounds. (tr-auth)

30110 ISOTOPIC ANALYSIS OF URANIUM BY AN OPTICAL SPECTRAL METHOD. I. DETERMINATION OF ^{235}N IN NATURAL AND DEPLETED URANIUM WITH D.C. ARC EXCITATION AND PHOTOGRAPHIC RECORDING. Z. Hainski and G. Rossi (CCR EURATOM, Ispra, Italy). Energia Nucl. (Milan), 12: 306-9(June 1965).

A preliminary study was made on the possibilities of establishing a spectrochemical method for ^{235}U in natural and depleted uranium. A Jarrell-Ash 3.4 m spectrograph was used in the 14th order of a grating having 7500 grooves/inch. In this way it is possible to separate the ^{235}U line at 4244.122 Å from the two unlisted interfering uranium lines at approximately 4244.098 and 4244.157 Å. A 10-amp d-c arc excitation and photographic recording were used. The intensity ratio of ^{235}U 4244.122/U 4243.55 is a linear relationship on a log-log scale with the ^{235}U concentration. The coefficient of variation (σ) as calculated on the mean value of 21 arcings at natural uranium level is equal to 5.62%. (auth)

30111 A SMALL MASS SPECTROMETER AS SENSITIVE LEAK DETECTOR AND RESIDUAL GAS ANALYZER. F. Bernhard (Humboldt-Universitaet, Berlin), H. Hoffmann, and E. Wilde. Exptl. Tech. Physik, 13: 31-7(1965). (In German)

The mass spectrometer described is, in its dimensions, a relatively small instrument. It possesses a high light intensity and good power of resolution. By application of permanent magnets, current stabilization of the magnets was sufficient. The necessary auxiliary devices (grid device, controllable high-voltage device, emission stabilization, and electrometer amplifier) are simple. The small mass spectrometer attains a detection sensitivity of 10^{-11} torr l/sec for He and permits a study of the mass range from 2 to 6 R with a resolution capacity up to 80 (with respect to the mean half-value width). (tr-auth)

30112 SEPARATION OF OXYGEN-17 FROM NATURAL OXYGEN IN THERMAL DIFFUSION COLUMNS. A. H. Narten and L. Landau (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 43: 751-5(July 15, 1965). (ORNL-P-1047)

Two prototype columns used as the basic unit in a thermal diffusion cascade for the final enrichment of oxygen-17 are described. An analysis of transient data from these two columns is made. Column parameters derived from this analysis were compared with parameters calculated from theory, using the Lennard-Jones (12/6) model. Discrepancies between observed and calculated column performance are discussed. (auth)

30113 DETERMINATION OF SOIL POTASSIUM BY NONDESTRUCTIVE ACTIVATION ANALYSIS. Chiung-huei Ke, Ching-yue Lin, and Hwa-sheng Cheng (National Tsing Hua Univ., Hsinchu, Taiwan). J. Chinese Chem. Soc. (Taiwan), 11: 193-201(Dec. 1964).

A rapid, accurate, and nondestructive method for analysis of soil potassium by neutron activation and scintillation spectrometry is described. With a short period of neutron irradiation (several minutes,) and a long cooling period, (a few days) only those nuclides of medium half life will survive, while the longer-lived nuclides have very low probability of activation. Hence, the bulk activity is essentially ^{24}Na and ^{42}K. Soil samples and standards were irradiated in a pneumatic rabbit at a neutron flux of 2×10^{12} n/cm^2/sec for 15 min. After cooling for one day, each sample was mounted on a cardboard and covered with Mylar film. The activity measurements were made with an end-window GM counter using 800- and 2000-mg/cm^2 aluminum absorbers alternatively. It was shown that the fraction of β activity not absorbed by 800-mg/cm^2 absorber is 0.0004% for 1.3-Mev β rays and 4.8% for 3.6-Mev β rays. Any β particle of energy less than 1.3-Mev is absorbed by the absorber of the thickness of 800-mg/cm^2. The results show the usefulness of nondestructive analysis of soil K by screening undesired activity with two aluminum absorbers of different thickness. The method is applicable to a wide variety of silicate minerals, e.g., silicate rock and minerals, clay minerals, or soil samples, when certain interfering elements are absent or negligible. (TCO)

30114 DETECTION OF TRITIUM ON PAPER AND THIN-LAYER CHROMATOGRAMS. A. T. Wilson and D. J. Spedding (Victoria Univ. of Wellington, N. Z.). J. Chromatog., 18: 76-80(Apr. 1965).

The techniques used to detect tritium on paper and thin-layer chromatograms are reviewed and their theory of operation and experimental limitations discussed. A simple technique is described whereby small amounts of tritium-labeled compounds may be detected on thin-film chromatograms. (auth)

30115 ELECTROLYTIC SEPARATION AND COLORIMETRIC DETERMINATION OF TRACES OF LEAD IN COBALT USING ISOTOPIC DILUTION ANALYSIS. A. Lagrou and F. Verbeek (Ghent Univ.). J. Electroanal. Chem., 9: 184-91(Mar. 1965).

Traces of lead in cobalt were determined colorimetrically with dithizone after a prior separation of the lead on to a mercury cathode using controlled potential analysis and subsequent distillation of the mercury in a nitrogen atmosphere. The total yield of lead was determined using the radioisotope ^{210}Pb. The conditions, i.e., electrolysis time, cathode potential, acidity, mercury volume, and lead concentration, for electrodeposition of micro quantities were investigated. Interferences of cobalt, mercury, indium, and bismuth were determined. (auth)

30116 RECENT DEVELOPMENTS IN THE APPLICATION OF NEUTRON ACTIVATION ANALYSIS TECHNIQUES TO FORENSIC PROBLEMS. V. P. Guinn (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Forensic Sci., 4: 184-91(Oct. 1964).

The sensitivity of high-flux neutron activation analysis for the quantitative detection of minute concentrations and minute amounts of many elements in many kinds of samples is being studied intensively for application in forensic studies. The work of several laboratories in this field is reviewed. The first three court cases in the United States, in which data obtained by the use of this method were introduced, are described. Each was successful. (auth)

30117 A METHOD FOR BETA COUNTING OF LARGE SAMPLES OF PLASMA BY LIQUID SCINTILLATION. Phillip M. Bloom and Wil B. Nelp (Univ. of Washington, Seattle). J. Lab. Clin. Med., 65: 1030-3(June 1965).

With the use of a liquid scintillator solvent containing toluene, Hyamine, and Cellosolve, beta activity in 2 ml samples of plasma was counted rapidly and efficiently. Samples were prepared in 20 seconds directly in the counting vial. Tritium was counted with an efficiency of 9.2% and carbon^{-14} with 66% efficiency. Because of the large volume of sample counted and the good efficiency of this method, preliminary concentration or extraction of isotope may be avoided when low levels of plasma radioactivity are counted. A modification of the solvent system was used to count tritium in 2 ml of urine with 9.7% efficiency. (auth)

30118 DETERMINATION OF ^{240}Pu AND ^{239}Pu RATIO BY SPONTANEOUS FISSION COUNTING. Jinzaburo Takagi (Nippon Atomic Industry Group Co., Ltd., Kawasaki-shi, Japan) and Noboru Oi. J. Nucl. Sci. Technol. (Tokyo), 2: 178-80(May 1965).

The ^{240}Pu content in Pu samples was determined by spontaneous fission measurement with a p-n junction silicon detector. Prolonged continuous measurements were run, extending over several hundred hours, using a transistorized counting system to obtain the required stability during such long periods. The results indicate that this method is also applicable to the determination of ^{240}Pu/^{239}Pu ratio. (auth)

30119 PRASEODYMIUM-143 FROM NEUTRON-IRRADIATED URANIUM. Tomitaro Ishimori and Yoshii Kobayashi (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 181-2(May 1965).

From neutron irradiated uranium cooled for about 2 days, ^{143}Pr was separated indirectly by solvent extraction. After removing uranium and some extractable nuclides with bis(2-ethylhexyl) orthophosphate from 10 M nitric acid solution, ^{143}Ce was extracted with bis(2-ethylhexyl) orthophosphate (n-heptane diluent) from a 10 M nitric acid solution containing potassium bromate. Then, ^{143}Pr was purified after most of the ^{143}Ce had decayed off. Detailed measurements indicated a half life of 13.55 ± 0.02 days and maximum β energy of 0.93 ± 0.05 Mev. (auth)

30120 TEST FOR RADIOCHEMICAL PURITY OF SODIUM RADIOIODIDE (^{131}I) SOLUTION U.S.P. BY THIN-LAYER CHROMATOGRAPHY. Elmore H. Taylor (Univ. of Tennessee, Memphis). J. Pharm. Sci., 54: 639-40 (Apr. 1965).

The use of thin-layer chromatography (TLC) in testing for the radiochemical purity of sodium radioiodide (^{131}I) solution is described. TLC is useful in quality control procedures because of its separatory efficiency, rapidity, simplicity, and relatively low cost. Separating iodide and iodate ions in determining the radiochemical purity of ^{131}I takes about 5 hr, but the TLC procedure, which gives equally good separation, can be completed in about 1 hr. The plates used are prepared with silica gel G, which is stirred with distilled water, then poured into an applicator and spread on glass plates. Standard solutions containing unlabeled potassium iodide (0.1%) and potassium iodate (0.2%), dissolved in 1% wt/v sodium bicarbonate solution, are used as reference substances. Developing solvent is 75% methanol, and time of development is about 40 min. The location and intensity of the radioactive zones on the developed plates are determined with a scanner at a speed of 0.75 in./min using a collimator slit width of 0.25 in. The plates are then sprayed with a 0.2% wt/v solution of ascorbic acid then with starch, the iodate zone giving an immediate blue color. The plates then are sprayed with a 5% wt/v solution of hydrogen peroxide, whereupon the iodide zone rapidly appears as a blue spot. (TCO)

30121 SIMULTANEOUS QUANTITATIVE DETERMINATION OF TWO γ-EMITTING ISOTOPES IN MIXTURE BY MEANS OF A SINGLE-CHANNEL AMPLITUDE ANALYZER. Csanyi Piroska Fodorne, Miklos Gallyas, and Bela Levay. Magy. Kem. Folyoirat, 71: 127-32(Mar. 1965). (In Hungarian)

In order to obtain the self-diffusion constants of alkali halides, ^{22}Na + ^{131}I and ^{137}Cs + ^{131}I must be determined quantitatively within the same mixture. A Frieseke-Hoepfner type one-channel amplitude analyzer, with the channel located between 0 and 99 v and a variable channel width between 0 and 30, provided with a NaI(Tl) crystal, was used as the γ spectrometer. The spectra obtained were evaluated by 3 methods previously described. The method of D. L. McIsaac (USNRDL-TR-72, 1956) was not found to be suitable for evaluating the photopeaks but the procedure developed by D. F. Covell (Anal. Chem., 31: 1785(1959)), developed specifically for the Cs–Zn system could be applied for this case. The 1 to 2% scatter in the results was considered to be acceptable. The area under the photopeak, calculated by means of Covell's equation did not reach the saturation value. The complete process of taking the spectra and evaluating them by this method requires 1½ to 2 hours and therefore cannot be used to follow time-dependent events. Work is in progress to overcome this disadvantage. (TTT)

30122 THE MEASUREMENT OF DOUBLE-LABELED RADIOACTIVE SUBSTANCES. Voedroes, Daniel; Miklos, Katalin (MTA Orvosradiologiai Kutato Csoportja, Budapest). Magy. Radiol., 17: 48-52(Feb. 1965). (In Hungarian)

The measurement of doubly labeled radioactive substances used in biology to trace metabolism of molecular component is discussed. Chemical means of separation are not necessary, since only the different radiations are measured. To successfully quantitate two radioactive labels there must be a difference either in the type of radiation emitted, in their half lives, or in the energy level emitted. Measurements based on the different types of radiation emitted might involve, for instance, use of ^{32}P and ^{51}Cr in blood cell studies. These tracers would then be measured by two different counters, each sensitive to one type of radiation. Mathematical formulas are given to calculate the radiation emitted. Calculations based on the half life of samples may be done by assaying the sample every 6 to 8 hr and plotting the results obtained on a semilogarithmic graph. By extrapolating the curve back to the Y axis at time zero, the original activity of both isotopes can be found. An example is cited with ^{24}Na and ^{131}I. Measurements based on radiation absorption were conducted with ^{24}Na and ^{42}K. A 500 mg/cm^2 absorption sheet was placed between the sample and the counter, thus screening out the β radiation of ^{24}Na (1.4-Mev) and measuring only the ^{42}K (3.58-Mev) β radiation. Graphs and mathematical formulas are provided to facilitate calculations. This method may be used with other preparations by selection of various filters. Scintillating spectrography may also be used for measurement of differential spectrum by setting the instrument for the photo peak of one and then the other radioisotope. These techniques cannot be used with all double-labeled isotopes, but may successfully be utilized in certain instances when there is substantial difference in the characteristics of the two isotopes. (BBB)

30123 THE DETERMINATION OF POTASSIUM IN SOIL BY MEANS OF GAMMA-SPECTROMETRY. Zmyslowska, S.; Brocas, J. Pedologie, 12: 175-9(1962). (In French)

A convenient way to determine the K content in soil is by measuring the β-activity of ^{40}K, which is in constant relationship to the total K content. A variation of this method

involves measuring the γ radiation of ^{40}K (1.45 Mev), which accompanies the β-disintegration of this radioisotope. However, both methods are only applicable if the soils are free of U and Th because the descendants of these elements, RaC(^{214}Bi) and ThC(^{212}Bi), emit γ rays of the same frequency (1.45 Mev) as ^{40}K. In order to determine to what extent U and or Th interfere with the γ-spectrometry of ^{40}K soil containing ^{40}K, U, and Th was measured spectrometrically and also by flame photometry and gravimetry. A comparison between γ spectrometric and flame photometric results showed differences up to 40% mainly in excess of the K actually present. These differences were caused by a disturbance in the radioactive equilibrium of U and Th with their daughter products in the soil due to elution by water or to the diffusion of radioactive gases like Rn and Tn. To obtain correct results a multichannel pulse height analyzer is necessary but the cost of this instrument, labor and calculations involved in its application are not justified. (OID)

30124 COMPARISON OF COLORIMETRIC AND X-RAY FLUORESCENCE METHODS FOR DETERMINATION OF MOLYBDENUM. Lingard, A. L.; Willigman, M. G. Proc. S. Dakota Acad. Sci., 42: 170-3(1963).

For direct comparison by x-ray fluorescence, standards containing 0.05 to 10% of MoO_3 in quartz were used. For the dilution technique, these standards were mixed with 10 times their weight of NaCl, then pressed into thin wafers. Calibration graphs of MoO_3 (%) vs. intensity of the Mo K_α line were prepared from these standards. The results from both these x-ray methods were compared with those obtained colorimetrically by the phenylhydrazine method. For samples containing >0.20% of MoO_3, values obtained by the direct-comparison method were significantly lower than those obtained by either the dilution technique or the colorimetric method. Although the last two procedures are accurate, x-ray fluorescence dilution requires only 20 min per sample, whereas 4 hr per sample is needed if the colorimetric method is used. (Anal. Abstr., 12: (Mar. 1965))

30125 AN AUTOMATED PROCEDURE FOR THE DETERMINATION OF OXYGEN USING FAST NEUTRON ACTIVATION ANALYSIS; OXYGEN IN STONY METEORITES. James R. Vogt and William D. Ehmann (Univ. of Kentucky, Lexington). Radiochim. Acta, 4: 24-8(May 1965).

An automated procedure was developed for the rapid and non-destructive determination of oxygen by fast-neutron activation analysis. Using an automated irradiation control system, as many as 60 samples per hour can be irradiated and counted. An IBM 1410 computer was used for rapid data reduction permitting a complete analysis in less than 4 minutes, including time for sample preparation. The method was very specific, the only appreciable interference being from fluorine. The application of the procedure to the determination of oxygen in meteorites is discussed and oxygen abundances for 34 chondrites, 5 achondrites, and standard rocks G-1 and W-1 are given. (auth)

30126 THE $^{204}Pb(n,p)^{204}Tl$ REACTOR CROSS-SECTION AND THE NEUTRON ACTIVATION ANALYSIS OF THALLIUM IN LEAD. J. Op de Beeck, A. Speecke, and J. Hoste (Universiteit, Ghent). Radiochim. Acta, 4: 32-5(May 1965).

The cross section for the transmutation reaction $^{204}Pb(n,p)^{204}Tl$ and the resulting apparent Tl concentration induced in lead samples, were experimentally determined by irradiation in a reactor. The method took into account the activity due to the transmutation reaction only, in the presence of ^{203}Tl impurity, which produces the same isotope through a (n,γ) reaction. A value of $\bar{\sigma}$ = 0.011 mb was obtained, whereas the estimated value, according to Roy and Hawton, is 0.03 mb. (auth)

30127 SOME ASPECTS OF THE INTERACTION OF BETA-RAYS WITH MATTER. C. L. de Ligny, T. Levering, and H. de Hoyer (State Univ., Utrecht). Rec. Trav. Chim., 84: 503-15(Apr. 1965).

The backscattering and absorption of β particles by compounds were measured and interpreted on the basis of elemental reflecting and stopping powers. A straightforward method was devised for the determination of the elemental stopping powers. The elemental reflecting powers were compared with the backscattering from elements and appeared to be in good agreement. A simple relationship was found to exist between the elemental reflecting and stopping powers. (auth)

30128 RECENT DEVELOPMENTS OF EMISSION SPECTRAL TECHNIQUES IN THE NUCLEAR RESEARCH FIELD. G. Rossi (EURATOM, Ispra, Italy). Rev. Univ. Ind. Santander, 5: 493-6(1963). (In Spanish) (EUR-1360.es)

Possibilities and developments of emission-spectra techniques applied to nuclear research problems, are shown. Results obtained, in particular, in the field of analytical determinations and isotopic determination, are reviewed. (auth)

30129 A STUDY ON SPECTROPHOTOMETRIC AND FLUORIMETRIC METHODS OF URANIUM ANALYSIS. Luigi Usoni and Anna Maria Marabini (CNR, Rome). Ric. Sci. Rend., Sec. A(2), 6: 721-8(Dec. 1964). (In Italian)

From among the main methods of determining the content of uranium in its ores, one fluorometric and two spectrophotometric methods were studied. These three methods are compared, and the sensitivity and reproducibility limits for large intervals of concentration are indicated. (auth)

30130 DETERMINATION OF ZIRCONIUM AND ITS SEPARATION FROM ALUMINUM AND TITANIUM BY ION EXCHANGE. Mikhova, M.; Katsarova, M. Stroit. Materiali Silikat. Prom., 4: 24-6(1963).

After heating 0.5 to 1 g of sample to fumes with H_2SO_4 and extraction of the residue with H_2O, 25 ml H_2SO_4 is added, and the solution is diluted to 100 ml. 10 to 50 ml of this solution is evaporated to dryness, and the residue is dissolved in 8 ml HCl. This solution is passed at 5 ml/min through a 35 × 1 cm column of Wofatit KPS (H^+ form; particle size 0.2 to 0.3 mm) previously washed with 2N HCl. The column is washed with 2N HCl to remove Al and Ti, and then Zr is eluted with 100 ml of 1:4 HCl. The column is washed again with 2N HCl. Zr is determined gravimetrically or by any other suitable method. (D.L.C.)

30131 MATRIX METHOD FOR DETERMINING THE RELATIVE CONTENT OF A GIVEN ISOTOPE WITHIN A SAMPLE. V. A. Fedorov and G. G. Doroshenko. Voprosy Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 30-1(1964). (In Russian)

It is often necessary to determine the relative abundance of a given isotope within an arbitrary sample consisting of several isotopes. A method is proposed based on the known total fast neutron or γ spectrum of the sample and the knowledge of the partial spectrum of each of the isotopes. The case using fast neutrons is described, but the method can also be used in cases when the spectra are discrete rather than continuous. This approach can be used in activation analysis. (CFSTI)

30132 ESTIMATION OF TRACES OF URANIUM IN WATER. Singer, Evzen; Marecek, Josef (Research Inst. for Inorganic Chemistry, Usti nad Labem, Czechoslovakia). Z. Anal. Chem., 196: 321-3(1963). (In German)

In this procedure 2 ml of NaCl (d. 1.18) is added to 1 l of the water sample. The sample is heated for 10 min until it is CO_2 free. Then 5 drops of methyl red and 3 ml of $AlCl_3$ are added to the warm solution, and it is neutralized with CO_2-free NH_4Cl (1 + 1) until a yellow precipitate is formed. The mixture is kept warm and allowed to stand for 2 hr. After this interval the clear supernate is discarded, and the precipitate is centrifuged. The precipitate is dissolved in 5 ml of saline solution with warming, and the resulting solution is made to 25 ml. A 1 to 5 ml sample of the solution is passed through a reductor, and 0.1 g of ascorbic acid is added. The velocity should be 1 or 2 drops/sec. The effluent is collected in a 25-ml flask that contains 5 ml of NaCl solution, 1 ml of 0.15% arsenazo-III solution, and 0.1 g of ascorbic acid. The reductor is washed through with NaCl solution until a total volume of 25 ml is collected. The color of the complex formed is measured at 66 mμ, and compared against a standard curve. With this proce-

dure as little as 1 μg of U/l can be determined with a relative standard deviation of 5%. (BBB)

30133 EXTRACTION OF CERIUM FROM NITRIC ACID SOLUTIONS WITH TERTIARY AMINES. A. Alian and N. Souka (Atomic Energy Establishment, Cairo). Z. Anorg. Allgem. Chem., 336: 306-12(Apr. 1965).

The system $R_3N-HNO_3-Ce(NO_3)_3$ was investigated. The partition of cerium(III) between nitric acid solutions and solutions of tri-n-dodecylamine (TDA) in odorless kerosene was studied by varying the nitric acid, amine, and salting-out agents concentrations. The obtained data are compared with those for neutral phosphorus organic compounds as well as for solid anion exchange resins. The mechanism of cerium extraction is discussed in the light of these results. Cerium extraction in the presence of uranium was also investigated. (auth)

30134 SPECTROPHOTOMETRIC DETERMINATION OF CERIUM IN CERIUM OXIDES. Illner, E. (VEB Carl Zeiss, Jena, Ger.). Z. Chem., 3: 472-3(1963).

Modifications are suggested for the determination of Ce at 252.8 mμ in 5% HCl medium. In order to improve the transmission of the final solution, the precipitated cerium hydroxide suspended in 5% HCl is treated with a few drops of 30% H_2O_2 solution, to reduce any Ce^{IV} to Ce^{III}, which is then readily soluble as chloride. Excess of H_2O_2 is decomposed by boiling. Oxidation of $Ce(OH)_3$ by atmospheric O can be prevented by working in an inert atmosphere. Interference caused by the presence of Fe^{3+} can be prevented by the addition of 1 ml of $SnCl_2$ solution (5% in 15% HCl) for each 50 ml of solution. This reducing agent can be used only if the spectrophotometric measurement is carried out between 240 and 325 mμ. (Anal. Abstr., 12: (Mar. 1965))

30135 A SIMPLE METHOD FOR DETERMINATION OF THE H/D RATIOS FROM FIELD ION-MASS SPECTRA OF H_2O/D_2O OR NH_3/ND_3 MIXTURES. E. L. Richter and W. A. Schmidt (Max-Planck-Gesellschaft, Berlin). Z. Naturforsch., 20a: 317-19(Feb. 1965). (In German)

The use of a field ion-mass spectra for the determination of the H/D ratios from H_2O/D_2O or NH_3/ND_3 mixtures is discussed on the basis of two examples. The studies were carried out on a 60° sector field mass spectrometer with a field emission ion source. Measurements made on water showed that the statistical distribution of the H-D exchange is in agreement with theory. The statistical and measured distributions for NH_3 were also in agreement. The mass numbers from 18 to 22 of the water spectrum were investigated in order to determine whether intensities can be described statistically. (J.S.R.)

30136 A REDETERMINATION OF THE ISOTOPIC COMPOSITION OF ATMOSPHERIC NEON. P. Eberhardt, O. Eugster, and K. Marti (Universitat, Bern). Z. Naturforsch., 20a: 623-4(Apr. 1965).

A redetermination of the isotopic composition of atmospheric neon gave abundance ratios $^{20}Ne/^{22}Ne = 9.80 \pm 0.08$ and $^{20}Ne/^{21}Ne = 338.0 \pm 2.5$, corresponding to percentage abundances of 90.50 ± 0.07, 0.268 ± 0.002 and 9.23 ± 0.07 for ^{20}Ne, ^{21}Ne, and ^{22}Ne, respectively. The abundances correspond to an atomic weight of 20.179 ± 0.002 for atmospheric neon. This value is in fair agreement with the international value of 20.183 based upon gas density measurements. (P.C.H.)

30137 CHEMICAL SPECTRAL ANALYSIS OF YTTRIUM AND YTTRIUM OXIDES. R. L. Slyusareva, L. I. Kondrat'eva, and Sh. I. Peizulaev. Zavodsk. Lab., 31: 557-9(1965). (In Russian)

Descriptions are given of a chemical-spectral method used for determining 15 elements in metallic yttrium and yttrium oxides. The method was based on concentration of impurities by means of yttrium extraction using tributylphosphate. The low-volatility impurities were determined by ashing and the volatile ones by fractionation evaporation with gallium oxide as carrier. The sensitivity of the method is 1×10^{-3} to 1×10^{-6}%. (R.V.J.)

30138 COMPLEXONOMETRIC DETERMINATION OF ZIRCONIUM USING STILBAZOGALL II AS AN INDICATOR. A. I. Cherkesov, Yu. V. Pushinov, and V. S. Tonkoshkurov (Saratov State Pedagogical Inst., USSR). Zh. Analit. Khim., 20: 459-61(1965). (In Russian)

A reagent stilbene-2,2′-disulfonic acid-4,4′-bis[(azo-1′′) 2′′-carboxy-4′′,5′′,6′′-trihydroxybenzene] (stilbazogal II), which is satisfactorily selective for zirconium ions in a strongly acid medium, was prepared. A method was developed for the direct complexometric determination of zirconium at pH 0.1 to 1.0 (1 to 2N HCl) in the presence of stilbazogall II as an indicator. Large amounts of Al^{3+} and Mg^{2+}, moderate amounts of UO_2^{2+}, Th^{4+}, Ti^{4+}, and many other ions did not interfere; the principal interfering ions were Hf^{4+}, Fe^{3+}, F^-, PO_4^{3-}, MoO_4^{2-}, and WO_4^{2-}. (auth)

30139 EXTRACTION OF SULFURIC ACID AND URANYL SULFATE BY N-ALKYLANILINES. O. E. Zvyagintsev, Yu. G. Frolov, Ching-pang Ch'en, and A. V. Val'kov. Zh. Neorgan. Khim., 10: 981-5(Apr. 1965). (In Russian)

The extraction of sulfuric acid and uranyl sulfate by N-alkylanilines was investigated and the necessity of correspondence of the acidity of the aqueous phase and of the basicity of the extractant for a possible recovery of the elements was found. The counter operation of diluents in the extraction of sulfuric acid and uranium(VI) sulfate was established. It is suggested that the solvation of the amine sulfate and the increase of the dielectric permeability of the solution impairs the extraction of the uranium and improves the extraction of the acid. By cryoscopic methods, the significant association of the N-alkylaniline sulfate in benzene solution was established. The mean number of molecules in association with increased concentration converges to 2.5. It was found that the distribution coefficient of uranium(VI) is increased with increased value of the alkyl groups in the N-alkylaniline molecule. (tr-auth)

30140 RECENT RADIOCHEMICAL PROCEDURES FOR BIO-ASSAY STUDIES AT TROMBAY. P. R. Kamath, I. S. Bhat, Kamala Rudran, M. A. R. Iyengar, Elizabeth Koshy, Urmila S. Waingankar, and Vasanti S. Khanolkar (Atomic Energy Establishment, Trombay, India). p.195-215 of STI/PUB/84(Vol.I).

The bio-assay laboratory at Trombay carries out nearly 2000 analyses of urine samples annually for different radionuclides. The most abundant isotopes of interest are ^{232}Th, ^{228}Th, ^{226}Ra, ^{224}Ra, and ^{228}Ra, U natural, fission products, and ^{239}Pu. Others are ^{60}Co, ^{131}I, ^{32}P, ^{137}Cs, ^{3}H, and ^{90}Sr. Analyses of a large number of samples containing low levels of activity with speed calls for development of special techniques when high specificity with good yields are desired. Urine presents a very complex matrix with a large amount of complexing organic material as well as variable salt content. Wet ashing procedures are time-consuming and cumbersome where samples of about 1 to 1.5 l are required to be destroyed. The paper presents some very recent methods developed in the laboratory and details of tracer studies involved in the development of these methods. The paper reports progress of work in the bio-assay laboratory from 1958 to date. (H.G.D.)

30141 IONOOBMENNAYA TEKHNOLOGIYA. (Ion Exchange Technology). K. V. Chmutov, ed. Moscow, Izdatel' stvo "Nauka," 1965. 280p.

The applications of ion exchange to the technology of separating mixtures of various kinds of materials, both organic and inorganic, are discussed. Subjects covered include the dynamics of the sorption process; ion exchange and oxidation-reduction chromatography for analytical work; recovery of citric acid, 8-hydroxy-quinoline, galanthamine, phenol, penicillin, enzymes (e.g. pepsin, lipase), rare and nonferrous metals, and halogens; separation of aromatic acid isomers from each other, cesium from rubidium, and sodium from lithium; determination of iron, cobalt, and nickel in pigments and alloy steels; purification of anatoxins and drugs; making of milk concentrates; demineralization of water; effect of the solvent on the equilibrium; liquid ion exchange; and precipitation chromatography. The practical and theoretical material presented

is considered useful for those considering introduction of new ion exchange processes into industry. (TTT)

30142 DETERMINATION OF SMALL AMOUNTS OF CARBON IN TUNGSTEN AND MOLYBDENUM. V. G. Shcherbakov and Yu. N. Yurkevich. p.317-26 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

Test pieces of W and Mo containing small amounts of C were burnt in a stream of pure O. The CO_2 formed was absorbed by a solution of barium hydroxide. From electrical conductance measurements of the solution the amount of carbon dioxide dissolved was determined. This method makes possible a determination of total carbon content of 0 to 0.001% with an accuracy of ±0.0002%. (Rev. Metal Lit., 22: No. 5, May 1965)

30143 SPECTROGRAPHIC METHOD OF DETERMINING IRON, ALUMINUM, MAGNESIUM AND SILICON IN TUNGSTEN AND MOLYBDENUM. V. I. Tumanov and S. I. Smorodinskaya. p.332-40 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

Preparations of highly pure specimens of W and Mo and quantitative spectrographic determination of the Fe, Al, Si, and Mg contents are described. (Rev. Metal Lit., 22: No. 5, May 1965)

30144 COMBINED DETERMINATION OF SODIUM, CALCIUM, IRON, ALUMINUM AND SILICON IN TUNGSTIC ANHYDRIDE. V. I. Tumanov, N. P. Anikeeva, and I. G. Lebedeva. p.341-5 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

The spectrographic determination of impurities of Fe, Al, Ca, Si, and Na, contained in tungstic anhydride is described. Simultaneous determination was possible using photographic plates of different sensitivity, obtaining optimum conditions for the excitation of the spectra, using an arc of requisite length, and having the electrodes of optimum shape. (Rev. Metal Lit., 22: No. 5, May 1965)

30145 NEUTRON ACTIVATION ANALYSIS FACILITY (Engineering Materials). (National Lead Co. of Ohio, Cincinnati). 10 drawings. (CAPE-1250)

A facility for neutron activation analysis, which makes use of the neutrons produced in a Cockcroft-Walton accelerator, is described. Neutrons are shot into the sample to be analyzed and the radiation induced in the sample is measured using a NaI(Tl) crystal with either a dual-channel or a 400-channel pulse-height analyzer. This method is rapid, sensitive, and nondestructive. The accelerator is housed in a concrete cave, which is connected to the main laboratory building where the controls are located. Two ft of BF in aqueous solution and 4 ft of concrete serve as biological shields. A cyclone fence surrounds the cave. The main entry door is connected to the high-voltage circuit. The voltage is cut off when the door is opened. The air in the cave is monitored to detect tritium and ^3He. The keys to the accelerator, entry door, and fence locks are welded to one ring. To open a gate or door the key must be removed from the accelerator, thus halting neutron production. (For Details, See TID-4100) (M.C.G.)

30146 PROCESS FOR REMOVING RADIOACTIVE MATERIALS FROM GASES AND PURIFYING PLANT THEREFOR. Lehmer, Wilhelm; Baldus, Wolfgang; Stich, Walter (to Gesellschaft fur Linde's Eismaschinen AG). Canadian Patent 709,054. May 4, 1965. Priority date Dec. 2, 1958, Germany.

In the method described for separating radioactive gases from reactor coolant gases, the absorber and piping are contained so that in the event of a break, the hazard to personnel is a minimum. There is also a countercurrent flow in which the cooling gas in the purifying lines are flowing towards the reactor so that even small leaks in the radioactive gas lines will not reach the surroundings. (F.S.A.)

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Refer also to abstracts 30675, 30743, and 31343.

30147 (BNL-9167) THE FREE ENERGY OF FORMATION OF THORIUM BORIDES FROM MEASUREMENTS ON SOLID EMF CELLS. S. Aronson and A. Auskern (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 10p. (CONF-650704-1). Dep. (mn); $1.00(cy), 1(mn) CFSTI.

From IAEA Symposium on Thermodynamics, Vienna.

Emf measurements were made on various thorium boride compositions in several cells at 800 to 950°C. The standard molar free energy of formation of ThB_6 and ThB_4 at 850°C was calculated to be −54.4 and -52.0 kcal/g-atom Th, respectively. Low emf values in one cell indicate that boron is only slightly soluble in thorium metal. The relative instability of ThB_6 and ThB_4 is discussed. (D.L.C.)

30148 (LA-3164) HEATS OF DISSOCIATION OF GASEOUS HALIDES. R. C. Feber (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Nov. 1964. Contract W-7405-eng-36. 185p. Dep.; $5.00(cy), 3(mn) CFSTI.

Heats of dissociation at 298.15°K of the gaseous fluorides, bromides, and iodides of elements of the first long period of the periodic table and beyond are calculated from available experimental data for the heats of formation of the condensed phases and data for vapor pressure and other equilibria. Results derived previously for the chlorides are included and in some cases modified or extended with subsequent data. Estimates are made for many of the halides for which experimental data are lacking. The previous review of heats of atomization of selected elements is extended to include several more elements and more recent vapor pressure data for the remaining elements. (auth)

30149 (ORNL-3789(p.3-35)) HIGH-TEMPERATURE PHASE EQUILIBRIUM STUDIES. R. E. Thoma, G. D. Brunton, J. H. Burns, H. A. Friedman, G. M. Hebert, H. L. Hemphill, D. R. Sears, B. J. Sturm, H. Insley, and T. N. McVay (Oak Ridge National Lab., Tenn.).

Equilibrium phase behavior was examined in systems of relevance to molten-salt reactor technology. A three-dimensional model of the $LiF-BeF_2-ZrF_4$ phase diagram was constructed. Reexamination was made of the $LiF-BeF_2$ system, using very pure mixtures of LiF and BeF_2. Equilibrium constants for the disproportionation of UF_3 were determined in a study of $UF_3 \rightleftharpoons UF_4$ high-temperature equilibria, showing solid solubility of UF_4 in UF_3. Fractionation experiments were conducted with the MSRE four-component fuel mixture $LiF-BeF_2-ZrF_4-UF_4$ at cooling rates approximating those in the reactor drain tanks. Crystallographic data were obtained for all solid phases in the $LiF-LnF_3$ and $NaF-LnF_3$ (Ln = La through Lu) binary systems, and phase diagrams were constructed for the 30 systems. A high-temperature fluorite phase was found in 12 of the NaF-based systems; its compositional variability is extended in proportion to the difference in Na^+/Ln^{3+} cation size. Hexagonal-orthorhombic transitions were determined for SmF_3, GdF_3, TbF_3, TmG_3, and LuF_3, using quenching and high-temperature x-ray methods. Further information relating cationic sizes with fluoride crystal chemistry was obtained in examinations of the systems $NaF-ScF_3$, $NaF-BiF_3$, and $KF-LaF_3$. Systems of potential use in advanced reactor technology, $KCl-UCl_3$, $NaF-KF-ThF_4$, and $LiF-NaF-ThF_4$, were examined with respect to liquid-solid equilibrium transitions and crystal phase properties. The crystal structure of $NaNdF_4$ and related compounds was established from single-crystal data. Accurate values for the atom positions in Li_2BeF_4 were obtained from a structural analysis of single crystals. (J.R.D.)

30150 (ORNL-3789(p.113-21)) CHEMISTRY OF PRESSURIZED-WATER REACTOR SYSTEMS. F. H. Sweeton, C. F. Baes, and R. W. Ray (Oak Ridge National Lab., Tenn.).

Studies of the chemistry of the pressurized-water loop at the ORR were continued until operation was shut down in the summer of 1964. With the water temperature at 149 to 176°C, average concentrations of corrosion product Fe, Ni, Mn, Cr, and Co were (in 10^{-9} M), respectively,

200, 150, 14, 3, and 1 as soluble species, and 40, 3, 0.1, 5, and <0.1 as suspended solids. The corrosion products (and the associated radioactivity) were thus largely in the soluble form. The behavior of dissolved material, the apparent recrystallization of suspended solids, and the results of further testing of magnetite absorbents, indicate that a bed of high-temperature magnetite might be used to recover radioactive corrosion products from circulating water in PWR systems. The solubility of Fe_3O_4, the normal corrosion product of PWR steel-water systems, was studied in pure H_2O saturated at room temperature with 1 atm of H_2. The results indicate that the solubility is $\sim 0.33 \times 10^{-6}$ M (in Fe) at 260°C, and 1.5×10^{-6} M at 200°C. (auth)

30151 (ORNL-3789(p.130-63)) PHYSICAL CHEMISTRY OF HIGH-TEMPERATURE AQUEOUS SYSTEMS. (Oak Ridge National Lab., Tenn.).

The electrical conductances of H_2SO_4 solutions were measured at 0 to 800°C and pressures to 4000 bars. Limiting equivalent conductances of H_2SO_4 were obtained as a function of temperature and density. The second ionization constant of H_2SO_4 was calculated to 300°C, and the first constant at 400 to 800°C. The dielectric constant of water to 800°C and 1.0 g/cm^3 was estimated. The second dissociation constant of H_2SO_4 was calculated at 25 to 350°C through the use of values for the solubility of $CaSO_4$ and its hydrates determined in aqueous H_2SO_4 solutions and NaCl solutions at the same temperatures. Limiting ionic conductances of potassium, sodium, hydrogen, chloride, bisulfate, and sulfate ions in water were estimated to 400°C. The limiting conductances of lithium, ammonium, and hydroxide ions were estimated to 300°C. Isopiestic studies of aqueous salt solutions were extended to 165°C with the results confirming observations previously made at 150°C. Previously reported measurements of the hydrolysis of Th^{4+} in 1 m $(Na)ClO_4$ solution at 0 and 95°C, along with similar measurements of others at 25°C, were analyzed by means of a general least-squares computer program to determine the simplest set (scheme) of hydrolysis products $Th_x(OH)_y^{(4x-y)+}$ with which they are consistent. The solubilities of $MgSO_4 \cdot H_2O$ (and $MgSO_4 \cdot D_2O$) were determined in $H_2SO_4-H_2O$ (and $D_2SO_4-D_2O$) solutions at 200 to 350°C and at concentrations of H_2SO_4 to 1.8 m. At solution concentrations of SO_3 (total sulfate) between approximately 10^{-4} and 0.1 m, the monohydrate was found to be hydrolytically unstable; it was converted partially to an oxysulfate or $Mg(OH)_2$ (or both) depending upon temperature and solution concentration. (J.R.D.)

30152 (ORNL-3789(p.164-80)) INTERACTION OF WATER WITH PARTICULATE SOLIDS. (Oak Ridge National Lab., Tenn.).

Differential heats of water adsorption on thoria were calculated for three samples from calorimetrically determined heats of immersion with varying amounts of presorbed water. Data for two of the three indicate a high degree of surface heterogeneity, while the third appears to possess regions of near homogeneity. Evidence is presented that the surface area is a function of the amount of water on the sample. Gravimetric adsorption-desorption studies of water vapor yielded type II isotherms with a high-relative-pressure hysteresis loop characteristic of porous solids. Exploratory experiments demonstrated the applicability of infrared spectroscopy to the identification of adsorbed species and their bonding characteristics. Thin thoria disks were prepared which seem to meet the requirements of high-resolution infrared spectroscopy. Waterlogging failure of a leaky fuel element is dependent on stresses imposed on the cladding as water is ejected by heat-up upon increasing reactor power. These stresses are interrelated functions of (1) the permeability of the fuel element, (2) the available void volume, (3) the geometry of the fuel elements, and (4) the rate of temperature rise. Experimental data indicate that an analytic interpretation of waterlogging stresses in terms of these variables and the pressure-volume-temperature properties of water is feasible. Gas evolution from sol-gel (thoria–3% urania) reactor fuel material was studied by outgassing samples at temperatures up to 1200°C. The amount of gas evolved was found to be a linear function of the surface area of the material. The composition of the gas, a mixture of CO_2, CO, H_2, and probably H_2O, also appeared to be strongly affected by the surface area of the material. Reversible adsorption of CO_2 was demonstrated; removal of CO_2 by outgassing was rapid and complete at 500°C and above. (J.R.D.)

30153 (ORNL-3789(p.183-201)) DIFFUSION PROCESSES. (Oak Ridge National Lab., Tenn.).

A mathematical model that describes gas transport in porous media as the migration of gas molecules through a uniformly distributed collection of giant molecules (dust particles) which are fixed in space, was extended to include the relative separation of two gas components as the result of a thermal gradient. The model predicts no separation at very low pressures (Knudsen region), and pressure-independent separation in the hydrodynamic region. The behavior varies with the temperature, molecular masses, and intermolecular forces of the gas molecules involved. Isothermal gaseous diffusion measurements were made with the systems He–Ar, Ar–Xe, and He–Xe at 0 to 120°C in an effort to resolve a previous discrepancy between directly measured diffusion coefficients for He–Xe mixtures and values determined from the composition dependence of the viscosity coefficients of such mixtures. The results are in good agreement with those derived from viscosity data. The migration behavior of actinides in pyrocarbons were investigated by thin-layer experiments that yield penetration data and diffusion coefficients related to the concentration profiles, and constant-potential experiments that yield estimates of the actinide solubility in pyrocarbons—as well as additional values of the coefficients. Results of thin-layer experiments indicate that no appreciable actinide migration occurs at temperatures below 1460°C. Preliminary results from constant-potential experiments verify the effect of concentration on actinide migration. It is concluded that structural changes induced by ultrahigh temperatures depress actinide migration, but structural changes induced by the presence of actinides enhance actinide migration. (J.R.D.)

30154 (ORNL-3789(p.308-17)) SUPPORT FOR SPACE PROGRAMS. (Oak Ridge National Lab., Tenn.).

The permeation rates of H_2 through type 316 stainless steel, in the presence of NaK at temperatures of 543, 593, and 704°C were found to differ little from values obtained in the absence of NaK. The solubility of H_2 in NaK-78 was determined at 300 to 704°C. For unsaturated solutions the solubility depended on the square root of the H_2 pressures, and varied slightly with temperature. At 300 to 400°C enough H_2 could be dissolved at pressures below 1 atm to result in precipitation of a metal hydride. Precipitation-decomposition pressures were consistent with the literature. The addition to NaK-78 of 1 to 4 at. % Li diminished the H_2 activity both by association with it in the NaK and by precipitation. The behavior suggests that dissolved H_2 exists in liquid metal mixtures as largely undissociated metal hydride molecules; fraction of the dissolved H_2 with a particular alkali metal depends on the concentration of that metal and its affinity for H_2. Development of the space materials properties center is described. (J.R.D.)

30155 (ORNL-TM-1129) OXIDE CHEMISTRY AND THERMODYNAMICS OF MOLTEN LITHIUM FLUORIDE–BERYLLIUM FLUORIDE BY EQUILIBRATION WITH GASEOUS WATER–HYDROGEN FLUORIDE MIXTURES. A. L. Mathews and C. F. Baes, Jr. (Oak Ridge National Lab., Tenn.). May 7, 1965. Contract W-7405-eng-26. 187p. Dep.(mn); $5.00(cy), 3(mn) CFSTI.

Thesis submitted by A. L. Mathews to Univ. of Mississippi.

The transpiration method was used to equilibrate dilute gaseous mixtures of HF and H_2O in hydrogen carrier gas with molten $LiF-BeF_2$ mixtures varying in composition from 0.25 to 0.80 BeF_2, both saturated and unsaturated with crystalline BeO, in the temperature range 500 to 700°C.

The partial pressure data were used to evaluate the equilibrium quotient for the reaction of HF and H_2O with solid BeO and dissolved BeF_2. Equilibrium quotients were also obtained for the formation of oxide and hydroxide ions in the liquid phase. These equilibrium quotients were employed to determine: (1) thermodynamic activities of LiF and BeF_2 in the mixtures; (2) thermodynamics of liquid BeF_2; (3) stability of hydroxide in the melt; and (4) solubility of BeO in the LiF–BeF_2 system as a function of temperature. (auth)

30156 (ORNL-tr-649) RADIOCHEMICAL MEASUREMENTS OF THE SOLUBILITY OF ALKALINE EARTH SULFATES IN WATER AND IN SODIUM SULFATE SOLUTIONS. K. H. Lieser. Translated by Hal H. Stone (Oak Ridge National Lab., Tenn.), from Z. Anorg. Allgem. Chem., 335: 225-36(Feb. 1965). 14p. Dep.(mn); $1.60(fs), $0.80(mf) JCL.

The solubility of $BaSO_4$ (traced with ^{140}Ba) and of strontium sulfate (traced with ^{90}Sr) in water and in sodium sulfate solution of various concentrations were measured radiochemically. The solubility of $CaSO_4 \cdot 2H_2O$ in sodium sulfate and sulfuric acid of various concentrations were determined through titrations. The mathematical analysis of the solubility curves indicates that, in saturated solutions of strontium sulfate and calcium sulfate in water, a relatively higher proportion of neutral molecules or ion aggregates are present. A complex formation involving sulfate ion was not recognizable. (auth)

30157 H–D ISOTOPIC EFFECTS IN THE BEHAVIOR OF ELECTRODES CONTAINING PALLADIUM POWDER. V. Znamirovschi ("Babes-Bolyai" Univ., Cluj). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 15: 247-51 (1964). (In Rumanian)

In view of the recent discovery that the potential of a powder may be used as a characteristic parameter for the dispersed phase, a method based on this property was used to determine the H–D isotopic effect on Pd powder. The half-cell used in the study consisted of a thin Pt wire encased in glass and surrounded by Pd powder; the system contained also a platinized Pt electrode and a single electrolyte of 2N H_2SO_4 through which H gas was bubbled. The behavior of the cell was examined when using ordinary and 50- and 100-% deuterated water, using a previously developed potential measuring technique. The measurements indicated an isotopic effect of the D, assuming a true H–D isotopic exchange mechanism between the chemisorbed and liquid phases. The method may be used as an analytical tool for determining the isotopic concentration of D in the water catalyzed by the Pd powder which thus affects the potential. (TTT)

30158 DETERMINATION OF THE BARRIER TO ROTATION HEIGHT OF THE H_3O GROUP IN CRYSTALLINE PERCHLORIC ACID MONOHYDRATE BY TOTAL NEUTRON SCATTERING CROSS-SECTION MEASUREMENT. Janina Janik (Jagellonian Univ., Krakow). Acta Physiol. Polon., 27: 491-5(Mar. 1965).

The total cross section for neutron scattering in the cold neutron region was measured for crystalline $H_3O \cdot ClO_4$ and liquid Ch_3I. From a comparison of the slopes of these cross sections vs neutron wavelengths it was deduced that the rotation of the hydronium group in $H_3O \cdot ClO_4$ is hindered. The barrier to rotation was evaluated as being approximately 1.8 kcal/mole. (auth)

30159 KINETICS OF THE URANIUM(IV)–IRON(III) REACTION AND METHODS OF END POINT DETECTION. T. M. Florence and P. J. Shirvington (Atomic Energy Commission Research Establishment, Lucas Heights, N. S. W., Australia). Anal. Chem., 37: 950-2(June 1965).

Amperometry at the dropping mercury electrode was used to derive a rate equation for the U(IV) + Fe(III) reaction in 1 to 8N H_2SO_4. Amperometry was also shown to be an accurate and precise method for detecting the end point. Data are presented in tables and graphs. An empirical rate equation, rate = $1200[H^+]^{-2.5}[U(IV)][Fe(III)]$ at 30°C, was derived. Results showed a relative standard deviation of ±0.35%, with no significant bias. Methods using platinum electrodes were found to be less precise. (M.C.G.)

30160 PROBLEMS IN THE ELECTROVALENCY OF GRAPHITE. A. R. Ubbelohde (Imperial Coll. of Science and Tech., London). Carbon, 2: 23-6(Aug. 1964).

The use of well-orientated graphite is discussed for the controlled formation of derivatives. Both electrochemical and related processes of intercalation can be followed with precision and in considerable detail. Obstructions preventing the swelling of graphite, which accompanies compound formation, can be evaluated quantitatively. Electrochemical, thermodynamic, and mechanical methods of estimating intercalations, swelling pressures, and thresholds were investigated for well-orientated graphites. The relevance of these findings is discussed in relation to various theoretical problems, and to practical applications such as those involving the durability of graphite electrodes. (auth)

30161 COMPLEX FORMATION BETWEEN URANYL IONS AND BETA-RESORCYLIC ACID. M. N. Desai and B. M. Desai (Gujarat Univ., Ahmedabad, India). Current Sci. (India), 34: 244-5(Apr. 20, 1965).

The formation of an orange-colored, water-soluble complex between uranyl ions and β-resorcylic acid with a maximum absorption in the range 454-478 mμ was observed. Three methods were used to determine the composition of the complexes. Results indicated a 1:1 complex and displacement of a phenolic proton of the resorcylate by the uranyl ion. (M.C.G.)

30162 OXIDATION OF n-BUTANOL BY CERIC IONS IN AQUEOUS SOLUTION. M. Rangaswamy and M. Santappa (Univ. of Madras). Current Sci. (India), 34: 282-3(May 5, 1965).

Experimental results in studies of oxidation of butanol by Ce^{4+} were explained on the basis of formation of a ceric-butanol complex with a 1:1 ratio and unimolecular decomposition of the complex as the rate-determining step. The results indicated that Ce^{4+} in aqueous solution and not $CeOH^{3+}$ in aqueous solution is the active species for oxidation. Fission of the O–H bond of alcohol accompanied by electron transfer to Ce^{4+} led to formation of n-butyraldehyde, which was oxidized to stable n-butyric acid. (F.J.H.)

30163 THE PROPERTIES OF THE FORMATES OF THE RARE EARTH ELEMENTS IN THE LANTHANUM–HOLMIUM SERIES. V. E. Plyushchev, L. P. Shhlover, L. M. Shkol'nikova, G. P. Kurnetsova, and G. V. Nadezhdina (Inst. of Fine Chemical Tech., Moscow). Dokl. Akad. Nauk SSSR, 160: 366-9(Jan. 11, 1965). (In Russian)

The formates of La, Pr, Nd Sm, Eu, Gd, Tb, Dy, and Ho were synthesized by reacting the freshly-precipitated rare earth hydroxide with formic acid HCOOH. The Ce compound was obtained by dissolving the carbonate in HCOOH. X-ray analysis gave values of the lattice parameter, a, which varied from 6.36 for the La compound to 6.13 Å for the Ho compound. This regular decrease in a was associated with lanthanide contraction. The pycnometric density increased regularly from 3.286 for the La compound to 4.110 for the Ho compound. The solubilities of the formates in water were determined at 25, 40, and 50°C. The solubility varied from 0.19 for the La compound to 10.39 wt % Me_2O_3 for the Ho compound at 25°C, and from 0.19 for the La compound to 8.20 wt % Me_2O_3 for the Ho compound at 50°C. On heating the formates from room temperature to 750 to 850°C, it was found that decomposition proceeds by the following scheme: $2Me(HCOO)_3 \rightarrow Me_2O_3 \cdot CO_2 \rightarrow Me_2O_3$. The cerium formate decomposed directly to CeO_2. Values of $-\Delta H^0$ were calculated, and were found to vary from 479.2 for the La compound to 447.5 kcal/mole for the Ho compound. (TTT)

30164 STUDIES OF ADDUCTS OF METAL SALTS WITH TETRAALKYL ALKYLDIPHOSPHONATES. I. PROTON MAGNETIC RESONANCE SPECTRA OF URANYL NITRATE ADDUCTS OF METHYLENEDIPHOSPHONATES IN $CDCl_3$. T. H. Siddall, III and C. A. Prohaska (E. I. du Pont de Nemours and Co., Aiken, S. C.). Inorg. Chem., 4: 783-8 (June 1965).

Proton magnetic resonance data are given for $CDCl_3$ solutions of uranyl nitrate adducts of tetraalkyl methylenediphosphonates. The data are interpreted in terms of

the effects on nearby proton of the anisotropic magnetic field from the uranyl group. (auth)

30165 A LIGHT-SCATTERING INVESTIGATION OF THE HYDROLYTIC BEHAVIOR OF THORIUM IN AQUEOUS PERCHLORATE MEDIA. Forrest C. Hentz, Jr. and S. Young Tyree, Jr. (Univ. of North Carolina, Chapel Hill). Inorg. Chem., 4: 873-7(June 1965).

The hydrolytic polymerization of thorium in solutions corresponding to 0.0, 1.0, 1.6, 2.0, and 3.0 bound hydroxide ions per thorium atom ($\bar{n}$ = 0.0, 1.0, etc.) was investigated by the light-scattering technique at 25°C. For each hydroxyl number, Th concentrations were varied between approximately 0.01 and 0.10 M in supporting electrolyte of 1.00 M $NaClO_4$. The degree of hydrolysis of the thorium ion was found to affect markedly the magnitude and the manner in which the turbidity, refractive index increment, and density vary with thorium concentration. Changes in pH and ultraviolet absorption spectra with degree of hydrolysis were less pronounced. An unhydrolyzed and uncomplexed Th^{4+} ion was confirmed at $\bar{n}$ = 0.0, while the species $[Th(OH)(ClO_4)_2]^+$ was found at $\bar{n}$ = 1.0. At hydroxyl numbers 1.6 and 2.0, average polymerization numbers of ca. 2.3 and 2.9 were found. Extremely large thorium aggregates containing 140–150 thorium atoms per particle were indicated in clear solutions at $\bar{n}$ = 3.0. The measurements on all series appear to be equilibrium values at 25°C, although slow kinetics cannot be ruled out for the later stages of hydrolysis. (auth)

30166 THE PHASE EQUILIBRIA AND CRYSTAL CHEMISTRY OF THE RARE EARTH GROUP VI SYSTEM. III. NEODYMIUM–TELLURIUM. W. Lin, H. Steinfink, and E. J. Weiss (Univ. of Texas, Austin). Inorg. Chem., 4: 877-81(June 1965).

The phases occurring in the neodymium–tellurium system are: NdTe, f.c.c. a = 6.278 Å., m.p. 2040°C. A solid solution series Nd_3Te_4–Nd_2Te_3, which has a high-temperature, Th_3P_4-type structure, whose cubic lattice constant varies from 9.434 to 9.424 Å, respectively; a phase transition occurs at 1000°C to an orthorhombic modification, Pbnm, a = 11.94 Å, b = 12.24 Å, c = 4.407 Å; Nd_3Te_4 melts at 1680°C and Nd_2Te_3 melts at 1620°C. A solid solution series exists over the composition range $NdTe_{1.74}$ to $NdTe_2$; the tetragonal unit cell for $NdTe_2$ has dimensions a = 4.419 Å, c = 9.021 Å, space group $P^4/_n mm$, and the compound melts at 1270°C. The phase Nd_2Te_5 is orthorhombic, pseudotetragonal, a = b = 4.380 Å, c = 44.0 Å, space group Bmmb, and melts incongruently at 910°. $NdTe_3$ is orthorhombic, Bmmb, and the dimensions of the pseudotetragonal cell are a = 4.350 Å, c = 25.8 Å. The compound melts incongruently at 830°C. (auth)

30167 CRYSTAL STRUCTURE OF HEXAGONAL SODIUM NEODYMIUM FLUORIDE AND RELATED COMPOUNDS. John H. Burns (Oak Ridge National Lab., Tenn.). Inorg. Chem., 4: 881-6(June 1965). (ORNL-P-976)

A single-crystal x-ray analysis established the structure of hexagonal $NaNdF_4$. The unit cell has a = 6.100, c = 3.711 Å; the space group is $P\bar{6}$. Fluoride ions lie in triangular arrays at z = 0, ½. Cation sites are of three types: a onefold site occupied by Nd^{3+}, a onefold site occupied randomly by $\frac{1}{2}Na^+$, $\frac{1}{2}Nd^{3+}$, and a twofold site occupied randomly by Na^+ and vacancies. The fluoride coordination about the first two sites is ninefold, a trigonal prism with each vertical face bearing a pyramid, and about the third site is irregular octahedral. It is proposed that this structure becomes the same as that of several other compounds having Nd^{3+} replaced by other rare earth ions or Y^{3+} and of the mineral gagarinite when the cations of the first two sites are completely intermixed. Bond distances and thermal displacements are given for $NaNdF_4$. (auth)

30168 THE PREPARATION AND OXYGEN-17 NUCLEAR MAGNETIC RESONANCE SPECTRUM OF $XeO^{17}F_4$. Jacob Shamir, H. Selig, David Samuel, and J. Reuben (Hebrew Univ., Jerusalem and Weizmann Inst. of Science, Rehovoth, Israel). J. Am. Chem. Soc., 87: 2359-60(June 5, 1965).

The preparation and ^{17}O NMR (nuclear magnetic resonance) spectrum of $Xe^{17}OF_4$ is described. The ^{17}O chemical shift is −313 ± 2 ppm (relative to $H_2{}^{17}O$) and the ^{129}Xe–^{17}O spin-spin coupling constant is 692 ± 10 cps. (auth)

30169 DEUTERIUM–HYDROGEN EXCHANGE ANALYSIS OF pH-DEPENDENT TRANSITIONS IN BOVINE PLASMA ALBUMIN. Benson, E. S.; Hallaway, Ben. E.; Lumry, Rufus W. (Univ. of Minnesota, Minneapolis). J. Biol. Chem., 239: 122-9(Jan. 1964).

To clarify the relation between H–D proton exchange and chain conformation in globular proteins, a study of the exchange properties and rotatory dispersion parameters of bovine plasma albumin was undertaken. Crystalline bovine plasma albumin and 99.5% D_2O were used for the preparation of density standards and for the H–D exchange experiments. The exchangeable H atoms of bovine plasma albumin in aqueous solution could be categorized as rapidly exchanging, slowly exchanging, and nonexchanging. The distribution function of the first-order rate constants of the slowly exchanging protons is such that this class is further divided into two subpopulations. The number of atoms per mole in each of these classes is dependent on the pH of the medium, with the possible exception of one of the slowly exchanging subpopulations (designated n_{2A}). H–D exchange could be related to accessibility of exchangeable atoms to solvent water. An increased accessibility at pH 3 to 4, as compared with pH 5, probably is the result of conformation changes in bovine plasma albumin as judged by the changes in optical rotatory properties and in other molecular parameters. An increased rate of exchange of n_{2B} protons probably does not represent an increase in motility, that is, unfolding-refolding fluctuations, of a part of the protein molecule in this pH range. The increased accessibility to exchange above pH 5 also may be the result of change in conformation or in equilibrium distribution of conformational isomers but, since rotatory dispersion parameters are unchanged from pH 5, the changes are probably more subtle than those at pH 3 to 4. There was no evidence of an increase in motility between pH 5 and 8.5 as judged by lack of dependence of rate constants on catalyst concentration. Thus H-D exchange cannot be readily equated with helix content at various pH values. Apparently, peptide H's of helix segments can exchange rapidly under appropriate circumstances, and protons not in helix segments may exchange slowly when incorporated in regions inaccessible to solvent. (BBB)

30170 ISOTOPE EFFECTS OF VIBRATIONAL TRANSITION PROBABILITIES. II. ELECTRONIC TRANSITIONS OF ISOTOPIC NITROGEN, NITRIC OXIDE, AND OXYGEN MOLECULES. M. Halmann and I. Laulicht (Weizmann Inst. of Science, Rehovoth, Israel). J. Chem. Phys., 43: 438-48(July 15, 1965).

Franck–Condon factors are given for the major electronic transitions of the normal and stable-isotope-labeled molecules N_2, NO, and O_2, for vibrational levels up to 10 of the $v'' = 0$ and $v' = 0$ progressions and for the (1,1) transition. Appreciable isotope effects on vibrational transition probabilities were found in the O_2 Schumann–Runge and Herzberg bands, in the O_2^+ second negative bands, in the NO beta and "M" bands, and in the N_2 Vegard–Kaplan bands. The magnitude of isotope effects on Franck–Condon factors was determined by differences in reduced masses between two isotopic molecules, as well as by differences in equilibrium internuclear distances between the two electronic states involved. The ratio of Franck–Condon factors of the light and heavy molecules decreased in the $v'' = 0$ and $v' = 0$ progressions with increasing quantum number. The isotope effect on r centroids was very small. (auth)

30171 MASS-SPECTROMETRIC STUDY OF GASEOUS OXIDES AND SUBOXIDES OF SCANDIUM, YTTRIUM, AND LANTHANUM. S. Smoes, J. Drowart, and G. Verhaegen (Universite Libre, Brussels). J. Chem. Phys., 43: 732-6 (July 15, 1965).

The dissociation energy of the molecule ScO was determined: $D_0^0(ScO)$ = 160.9 ± 3.5 kcal/mole. The dissociation energies of the molecules YO and LaO, $D_0^0(YO)$ = 168.6 ± 2.8 and $D_0^0(LaO)$ = 191.0 ± 2.5 kcal/mole, are discussed. The molecules Sc_2O, Y_2O, Y_2O_2, La_2O, and La_2O_2 were

identified. Their atomization energies are: $D^0_0(Sc_2O)$ = 245 ± 11, $D^0_0(Y_2O)$ = 258 ± 8, $D^0_0(Y_2O_2)$ = 445 ± 12, $D^0_0(La_2O)$ = 266 ± 8, $D^0_0(La_2O_2)$ = 468 ± 11 kcal/mole. (auth)

30172 INFRARED SPECTRUM OF $^{12}C^{18}O_2$. Charles Chackerian, Jr. and David F. Eggers, Jr. (Univ. of Washington, Seattle). J. Chem. Phys., 43: 757-8(July 15, 1965).

A number of vibration-rotation absorption bands of $^{12}C^{18}O_2$ lying in the region between 1800 and 5000 cm^{-1} were analyzed and the derived vibrational-band centers are reported. The Fermi interaction constant W_0, which gives the best fit to the data, essentially confirms the determination of others who analyzed the $\nu_1 + \nu_3$ and $2\nu_1 + \nu_3$ bands. Data are tabulated. (P.C.H.)

30173 ANTIRADIATION COMPOUNDS. VII. LONG-CHAIN ALKYL DERIVATIVES OF 2-MERCAPTOETHYLGUANIDINE. William O. Foye, Edward F. LaSala, Minas Georgiadis, and Walter L. Meyer (Massachusetts Coll. of Pharmacy, Boston). J. Pharm. Sci., 54: 557-60(Apr. 1965).

A series of long-chain N-alkyl and N,N′-dialkyl derivatives of 2-mercaptoethylguanidine (MEG) was prepared, with the assumption that increase in liposolubility will improve antiradiation effectiveness. These compounds were isolated from aqueous solution, generally as the hydrobromide; however, compounds of better crystalline properties were obtained by conversion of the MEG derivatives to the trithiocarbonates. Further evidence that these adducts are trithiocarbonates and exist as zwitterions was provided by proton nuclear magnetic resonance analysis. The N-alkyl and N,N′-dialkyl derivatives of MEG were prepared by reaction of the corresponding thiourea with bromoethylamine hydrobromide to give the substituted isothiouronium compound. The dialkyl thioureas were prepared by conversion of long-chain alkyl amines to the dithiocarbamates, followed by heating, whereas the monoalkyl thioureas were obtained by conversion of the amines to isothiocyanates using thiophosgene. The isothiouronium compounds were rearranged to the corresponding MEG derivatives in aqueous ammonia, and isolated as monohydrobromides. Formation of the trithiocarbonates of the mercaptoethylguanidines was performed by treatment of either the AET or the MEG derivative with carbon disulfide in aqueous ammonia. Nuclear magnetic resonance analysis indicated that the MEG-carbon disulfide adduct has the trithiocarbonate structure and thus that here, as with similar derivatives of 2-mercaptoethylamine (MEA) and its N,N-diethyl analog, carbon disulfide becomes attached to sulfur rather than to nitrogen. Tests for the ability of several of the MEG derivatives to protect mice against a lethal dose of x radiation were carried out, but the results are only briefly reported. In tests on N-myristyl-2-aminoethylisothiouronium bromide hydrobromide and N-myristyl-2-mercaptoethylguanidine trithiocarbonate in doses of 50 mg/kg or less, neither compound was protective for the mice. Details of synthesis and analysis of these compounds are given. (TCO)

30174 MECHANISM OF THE ELIMINATION OF HIGH-INTENSITY RECIPROCITY LAW FAILURE BY GOLD-SENSITIZATION. Faelens, P. (Gevaert Research Labs., Mortsel, Belg.). J. Phot. Sci., 13: 54-5(Jan.-Feb. 1965).

Potentiometric measurements led to the conclusion that, when ripening silver bromide suspensions with gold thiosulphate, considerably greater amounts of S^{2-} ions are built into the grain than in the case of ripening with equivalent amounts of sodium thiosulphate. The elimination of high intensity reciprocity failure by gold sensitization must be due to the greater number of Ag_2S specks distributed on the surface of the grain. (auth)

30175 CHEMISTRY OF THE ACTINIDE ELEMENTS. A SUMMARY. Fodor, Miklos (MTA Kozponti Fizikai Kutato Intezet, Budapest). Magy. Tud. Akad. Kem. Tud. Oszt. Kozlemen., 23; 147-89(1964). (In Hungarian)

A comprehensive review of the literature covering the chemistry of actinide elements is given and reference is made to 188 publications on the subject, many published in Hungary. The importance of actinide elements, mining methods, and production of transuranium elements are discussed. Data published in Hungary includes basic research on chemical uses of uranium; also examined were concentration of the carbonate, temperatures employed, use of oxidizing substances such as ($KMnO_4$), its amount and time of addition, and its effects on uranium yield. Research was conducted on the uranyl-tricarbonate complex in relation to various resin procedures; also on di- and tri-2-ethylhexyl phosphoric acid and various other phosphates and their U-extracting properties. Extensive treatment is devoted to production of transuranium elements, electronic structure of actinides, actinide metals, solid actinide alloys, coordinate chemistry of actinides, ion-exchange characteristics of actinides, and their analytical chemistry. Various methods of extraction and distillation are described in detail and photometric methods of analysis as well as that of fluorimetry and complexometry of the elements are considered. Methods of polarography, radiometry, and spectrophotometry are also reviewed. (TCO)

30176 β-DECAY IN PREPARATIVE NOBLE GAS CHEMISTRY. G. J. Moody and J. D. R. Thomas (Welsh Coll. of Advanced Tech., Cardiff, Wales, U. K.). Nature, 206: 613(May 8, 1965).

The general principle that the abundance of an intact parent carbon-noble gas ion depends on the carbon-noble gas bond strength, as well as the recoil energy imparted to such bonds from β decay is discussed. The possibility of preparing a neon fluoride as well as chlorides and bromides of xenon are considered. (P.C.H.)

30177 OXYGEN EXCHANGE REACTION BETWEEN LACTOSE AND WATER IN THE PRESENCE OF GROUP V, VI METALLIC IONS AND URANYL ION AS CATALYSTS. Kokichi Goto (Nara Women's Univ., Kitauoya-Nishimachi, Japan). Nippon Kagaku Zasshi, 86: 506-8(May 1965). (In Japanese)

It was found that hydrolysis of lactose took place in 180-labeled water with small amounts of VSO_4, $CrCl_3$, Na_2MoO_4, or Na_2WO_4 present. The hydrolysis was not detected without these ions. The addition of $SbSO_4$ and $UO_2(NO_3)_2$ hardly promoted the hydrolysis. The mechanism of the reaction can be attributed to the loosening of the C–OH bond as a result of the electronic displacement by the coordination of the metallic ions to the secondary alcohol group of lactose. Since the activity of Cr^{3+} was as high as that of Rh^{3+}, the catalytic actions of both ions were considered to be the same. That the activity of MoO_4^{2-} is greater than WO_4^{2-} may be related to the difference in ionic radii, though both are considered to coordinate to the OH group of lactose. (auth)

30178 ISOTOPIC SHIFT OF THE RESONANCE 3988 Å LINE OF YTTERBIUM. Yu. Chaiko (Inst. of Nuclear Studies, Czechoslovak Academy of Science, Prague). Opt. Spectry. (USSR) (English Transl.), 18: 200-1(Feb. 1965). Translated from Opt. i Spektroskopiya, 18: 351-2(Feb. 1965).

Measurements were made of the isotopic shift of the 3988 Å line of ytterbium and the hyperfine structure recorded photoelectrically. Direct measurements were made of the shifts by the method of alternation of interference maxima. The absolute values of the shifts were approximately one half those of the 5556 Å line. Data are presented in tables. (M.C.G.)

30179 COOLING BY MEANS OF ANISOTROPIC HYPERFINE STRUCTURE COUPLING; ORIENTATION AND RELAXATION OF NUCLEAR SPIN SYSTEMS IN STRONG MAGNETIC FIELDS. J. Lubbers, A. R. Miedema, and W. J. Huiskamp (Kamerlingh Onnes Laboratorium, Leiden). Physica, 31: 153-92(Feb. 1965).

A new method is given for obtaining low temperatures in paramagnetic crystals in the presence of a large magnetic field by utilizing anisotropic hyperfine structure coupling. The method consists essentially of reduction of hfs splittings by rotation of a magnetic field under adiabatic conditions. A discussion of the requirements on the properties of the usable paramagnetic ions is given. The usefulness of the method was demonstrated with crystals of $CoCs_2(SO_4)_2 \cdot 6D_2O$ in which ^{54}Mn was incorporated in order to serve as a thermometer. The ratio between initial and final temperature was 4 to 5, resulting in a lowest temperature

of 0.006°K, which could be maintained for at least one hour. In high magnetic fields establishment of thermal equilibrium between the ^{54}Mn and stable ^{59}Co nuclei could not be obtained, indicating extremely long relaxation times in the interaction of nuclear spins of unlike paramagnetic ions. However, for medium field strengths relaxation time measurements could be carried out as a function of field strength, of the direction of the field and of the temperature. It was found that the relaxation time was very strongly dependent on the field strength when the field was in a fixed direction, but was approximately constant for a fixed value of the sum of electronic Zeeman splittings of Mn and Co ions, when varying both the direction and magnitude of the field. Gamma ray intensity measurements of ^{54}Mn at a very high degree of nuclear polarization (>97%) resulted in the establishment of an upper limit to the possible disturbance of the ^{54}Mn nuclear polarization due to K capture or to its after-effects. The rotational cooling procedure was further investigated by measurements of anisotropies of ^{60}Co gamma radiation; the main features of the experimental results, obtained for various field directions, were in agreement with theoretical predictions. However, at the lowest temperatures significant deviations were found. ^{137}Cs nuclei were oriented by electric coupling; peculiar relaxation phenomena were observed which led to the conclusion that ^{137m}Ba has a negative sign for its nuclear electric quadrupole moment. The magnitude of the crystalline electric field gradient was found to be at least a factor of 30 larger than that found by Kiddle and Proctor by means of nuclear quadrupole resonance at room temperature. The relaxation time for establishment of thermal equilibrium between Cs and Co-nuclei was found to be a few orders of magnitude shorter than that between Co and Mn nuclear spins. Negative results concerning attempts to orient ^{134}Cs, ^{86}Rb, and ^{83}Rb are reported. (auth)

30180 ISOTROPIC EXCHANGE INTEGRAL IN COPPER PROPIONATE MONOHYDRATE. S. Mitra and P. Sengupta (Indian Association for the Cultivation of Science, Jadavpur, Calcutta). Physica, 31: 362-4(Mar. 1965).

The magnetic behavior of copper propionate monohydrate, studied between 300°K and 90°K, shows an antiferromagnetic exchange interaction within the pairs of Cu^{2+} ions. The exchange integrals for both parallel and perpendicular directions of the ionic clusters were calculated and are found to be isotropic. (auth)

30181 POSSIBLE CURIUM(VI) IN AQUEOUS SOLUTION. Johkun Akatsu (Japan Atomic Energy Research Inst., Tokyo). Radiochim. Acta, 4: 58-60(May 1965).

Americium and curium were oxidized to a higher oxidation state in acetate buffer solution treated with ozone. Both of their K_d values varied inversely with first-power dependence on the concentration of acetate. It was assumed that both americium and curium were oxidized to the VI state. In addition to an ion exchange study, a solvent extraction of the ions using 3% solution of Amberlite LA-1 in kerosene as an upper layer and acetate buffer solution as a lower layer was carried out. It was suggested that the increase of K_d values was not brought about by the ion exchanger or the extractant used, but by treatment with ozone. It was clear that curium treated with ozone was absorbed by anion resin or extracted with long-chain alkyl amine. It was assumed that this behavior was brought about by the oxidation of curium to the hexavalent. (F.J.H.)

30182 REFRACTOMETRIC STUDIES OF THE FORMATION OF YTTERBIUM HALOGENIDE COMPLEXES IN AQUEOUS SOLUTIONS. P. Spacu, Ileana Albescu, and Eugenia Dragomir (Research Inst. for Inorganic Chemistry, Bucharest). Rev. Roumaine Chim., 10: 17-26(Jan. 1965). (In German)

Systems of the type $YbX_3 - Me^IX$ (where X = Cl and Br and Me^I = Na and K) in concentrated aqueous solutions were investigated on the basis of the refractometric method and the molar ratio method. In the chloride series the most stable compounds are of the type $Me^I(YbCl_4)$ and the least stable are the compounds $K_2(YbCl_5)$ and $K_3(YbCl_6)$. For the bromides no compounds of higher order could be obtained in 0.5 M solution. It was theoretically predicted that the bromides would be less stable and could not be detected by these methods. (tr-auth)

30183 PHYSICAL-CHEMICAL STUDIES OF THE URANYL NITRATE-MUCIC ACID SYSTEM. Florica Popea, Maria Mavrodin, Elena Antonescu, and Sylvia Plostinaru (Research Inst. for Inorganic Chemistry, Bucharest). Rev. Roumaine Chim., 10: 35-8(Jan. 1965). (In German)

The system UO_2^{2+}-mucic acid was spectrophotometrically studied, and an attempt was made to determine the chemical structure of this system through conductometric titration. Neither the method of continuous variations, the molar ratio method, nor the straight-line method led to conclusive results. In the conductometric titration for various UO_2^{2+} concentrations, the curve showed a break for the ratio $2UO_2^{2+}$: 1 mucic acid. The formation of this compound was promoted by the presence of adjacent carboxyl and hydroxyl groups of the mucic acid and by the pH value of 4.7 of the reaction medium. (tr-auth)

30184 SPECTROPHOTOMETRIC AND CONDUCTOMETRIC STUDIES OF THE SYSTEMS: $UO_2^{2+} - CH_2ClCOO^-$; $UO_2^{2+} - CHCl_2COO^-$; $UO_2^{2+} - CCl_3COO^-$. P. Spacu, Florica Popea, and Constanta Tohaneanu (Research Inst. for Inorganic Chemistry, Bucharest). Rev. Roumaine Chim., 10: 39-46(Jan. 1965). (In German)

The systems $UO_2^{2+} - CH_2ClCOO^-$, $UO_2^{2+} - CHCl_2COO^-$, and $UO_2^{2+} - CCl_3COO^-$ were investigated spectrophotometrically and by conductometric titration. For the system $UO_2^{2+} - CH_2ClCOO^-$, the complex $[UO_2^{2+}(CH_2ClCOO)_3]^-$ with the dissociation constant $4.91 \pm 1.8 \times 10^{-4}$ mol^3/l^3 was detected spectrophotometrically. The compounds $[UO_2(RCOO)]^+$, $[UO_2(RCOO)_2]$, and $[UO_2(RCOO)_3]^-$ (R = CH_2Cl, $CHCl_2$, and CCl_3) were detected by conductometric titration. (tr-auth)

30185 SPECTROPHOTOMETRIC AND CONDUCTOMETRIC STUDIES OF THE SYSTEM $UO_2^{2+} - CH_2BrCOO^-$. P. Spacu, Florica Popea, and Constanta Tohaneanu (Research Inst. for Inorganic Chemistry, Bucharest). Rev. Roumaine Chim., 10: 47-51(Jan. 1965). (In German)

The system $UO_2^{2+} - CH_2BrCOO^-$ in aqueous solution was studied by conductometric titration and the presence of the compounds $[UO_2(CH_2BrCOO)]^+$, $[UO_2(CH_2BrCOO)_2]$, and $[UO_2(CH_2BrCOO)_3]^-$ were detected. The complex $[UO_2(CH_2BrCOO)_3]^-$ with the dissociation constant $3.89 \pm 0.02 \times 10^{-4}$ mole^3/l^3 was also detected spectrophotometrically through the straight-line method. (tr-auth)

30186 SPECTROPHOTOMETRIC AND CONDUCTOMETRIC STUDIES OF THE SYSTEM $UO_2^{2+} - CH_2ICOO^-$. P. Spacu, Florica Popea, and Constanta Tohaneanu (Research Inst. for Inorganic Chemistry, Bucharest). Rev. Roumaine Chim., 10: 53-7(Jan. 1965). (In German)

The system $UO_2^{2+} - CH_2ICOO^-$ in aqueous solution was investigated spectrophotometrically by the straight-line method and by conductometric titration. The complex $[UO_2(CH_2ICOO)_3]^-$ with the mean value for the dissociation constant of $5 \pm 1.5 \times 10^{-4}$ mole^3/l^3 was detected by the first method; the compounds $[UO_2(CH_2ICOO)]^+$ and $[UO_2(CH_2ICOO)_2]$ were detected by the second method. (tr-auth)

30187 THE INDUCTIVE EFFECT OF HALOGENS ON THE STABILITY IN AQUEOUS SOLUTION OF URANYL ION COMPOUNDS WITH SOME HALOGEN DERIVATIVES OF ACETIC ACID. P. Spacu, Florica Popea, C. Lepadatu, and Constanta Tohaneanu (Research Inst. of Inorganic Chemistry, Bucharest). Rev. Roumaine Chim., 10: 59-65(Jan. 1965). (In German)

The presence in aqueous solution of complexes of the type $[UO_2(RCOO)_3]^-$ (R = CH_2Cl, CH_2Br, CH_2I, $CHCl_2$, and CCl_3) was detected spectrophotometrically and by conductometric titration and their dissociation constants were determined. An attempt was made to explain qualitatively the variation of the complex stability dependent on the change of the electron density in the area of the uranyl–ligand bond. (tr-auth)

30188 MONOMOLECULAR LAYERS OF COMPLEXES BETWEEN TRIBUTYL PHOSPHATE (TBP) AND THORIUM

AND URANYL NITRATE. Gerolamo Devoto, Enzo Ferroni, and Paola Bionducci Serra (Universita, Cagliari, Italy). Ric. Sci. Rend., Sez. A, 7: 249-54(Dec. 1964). (In Italian)

The formation of monomolecular condensed layers was followed by measuring the height of the band of the reflected light from the layer surface waved by a synchronous rippler of suitable frequency. In doubly distilled water, the area per molecule of TBP agreed with the condensed arrangement of molecules of TBP with the P-O bond perpendicular to the interface. In $Th(NO_3)_4$ and $UO_2(NO_3)_2$ solutions it was possible to verify the existence of different monomolecular layers attributable to the formation of complexes in different mole ratios. (auth)

30189 DETERMINATION OF THE CHEMICAL STRUCTURE OF COORDINATED LANTHANOID COMPOUNDS BY MEANS OF THEIR ABSORPTION SPECTRA. K. B. Yatsimirskii, N. K. Davidenko, N. A. Kostromina, and T. V. Ternovaya (Inst. of General and Inorganic Chemistry, Kiev). Teor. i Eksperim. Khim., 1: No. 1, 100-5(Jan.-Feb. 1965). (In Russian)

The nepheloxetic effect (decrease of the parameter of interelectron repulsion B in complex compounds in comparison with gaseous ions) characterizes the regression of chemical bonds from the ionic type. Between the parameters B in complexes of the d-transition metals and the size of the comparative long-wave displacement of the $\Delta\nu$ band in spectra of Pr and Nd compounds ($\Delta\nu$ is the difference of the wave number of the bands in complexes and in aqua-ions) with the same ligands a linear dependence exists. The size of the displacement $\Delta\nu$ depends on the nature of the bonds of the lanthanoids with the ligands. The size of the comparative displacement of the bands $^4J_{\frac{9}{2}} \rightarrow {}^2P_{\frac{1}{2}}$, corresponding to the formation of Nd bonds with dissociated carboxyl, alcohol, and hydroxyl groups, was determined. The additivity of the size of the comparative displacements of these bands was established. Increments of the groups cited were found. Increments were used for the determination of the structure of the intraspherical complexes of Nd with hydroxy acids and complexes in aqueous solution. By splitting the $^4J_{\frac{9}{2}}$ (Nd^{3+}) and $^5D_2$(Eu^{3+}) levels, the type of symmetry of the aqua-ions (C_4) and ethylenediaminetetraacetate (C_{4v}), nitrilotriacetate (C_{3v}), and diethylenetriaminepentaacetate (C_{3v}) complexes of Nd and Eu was established. (tr-auth)

30190 ISOTOPIC EXCHANGE OF OXYGEN WITH VARIOUS OXYGEN CONTAINING URANIUM COMPOUNDS. E. G. Lavut and Vikt. I. Spitsyn. Teor. i Eksperim. Khim., 1: No. 1, 106-16(Jan.-Feb. 1965). (In Russian)

The isotopic exchange between gaseous oxygen and the uranium compounds α-Na_2UO_4, β-Na_2UO_4, $Na_2U_2O_7$, UO_3(A), γ-UO_3, α-$UO_{2.94}$, and U_3O_8 was investigated. Qualitative experiments with UO_2F_2 and $Cs_2UO_2Cl_4$ were carried out. The periods of semi-exchange were determined for U_3O_8, α-$UO_{2.94}$, $Na_2U_2O_7$, and β-Na_2UO_4 for different temperatures; the coefficients of self-diffusion of oxygen into the crystalline lattices UO_3(A), γ-UO_3, $Na_2U_2O_7$, α-Na_2UO_4, and β-Na_2UO_4 were calculated. The activation energies of surface exchange and diffusion were calculated. It was concluded that all oxygen atoms in the compounds investigated are equal with respect to isotopic exchange; in the series of substances studied the activation energies of the surface exchange and diffusion increases with increasing atomic ratio U:O. It was established that because of the diffusional character of the exchange a periodicity of the fluctuation of the process speed was observed that could not be ascribed to mistakes in the measurement; an explanation of the mechanism of this phenomenon is proposed. (tr-auth)

30191 INVESTIGATION OF ION-MOLECULAR REACTIONS AND DISSOCIATIVE RECOMBINATION IN THE UPPER ATMOSPHERE AND IN THE LABORATORY. A. D. Danilov and G. S. Ivanov-Kholodnyi. Usp. Fiz. Nauk, 85: 259-6(Feb. 1965). (In Russian)

Data on ion-molecular reactions and dissociative recombination in the upper atmosphere and in the laboratory are reviewed and work dealing with the determination of their role in the upper layers of the atmosphere is summarized. Difficulties, contradictions, and points of view that arise in the solution of these problems are discussed. Dissociative recombination in the ionosphere is discussed under the following headings: definition and theoretical calculations, use of the dissociative recombination process in ionospheric research, effective recombination coefficient and principal reactions with ions in the ionosphere, measurement of the effective recombination coefficient in the E and F1 layers of the ionosphere, deductions concerning the rate constant of dissociative recombination from measurements of the effective recombination coefficient, measurement of the rate constant in the lower part of the ionosphere, and measurement of the effective recombination coefficient in the F2 layer of the ionosphere and deductions concerning the rate constant. In discussion of the ion-molecular reaction it is shown that whereas ion-molecular processes play a decisive role in the formation behavior of the ionosphere, the question of the quantitative measures of this effect still remains open. Laboratory investigations were devoted for the most part to determination of the rate constant of dissociative recombination for the ions most abundant in the ionosphere (N_2^+, O_2^+, and NO^+). (CFSTI)

30192 ON OXYSCANDATES. I. ON THE KNOWLEDGE OF $CaSc_2O_4$. Hk. Mueller-Buschbaum and H. G. Schnering (Universitat, Munster, Ger.). Z. Anorg. Allgem. Chem., 336: 295-305(Apr. 1965). (In German)

$CaSc_2O_4$, till now unknown, was prepared and investigated. The colorless compound contains 4 formula units in the orthorhombic unit cell (space group $^{16}D_{2h}$-Pnam, a = 9.65, b = 11.20, c = 3.16 Å). The crystal structure was determined by Patterson and Fourier synthesis. For the (hkl) reflexes the residual factor is R = 0.132, R′ = 0.201. $CaSc_2O_4$ is isotopic with $CaFe_2O_4$. A detailed discussion of the structure connected with the Strukturchemische Volumenregel of Gattow is given. (auth)

30193 INVESTIGATIONS ON THE RARE EARTH–TERPYRIDYL SYSTEM. I. PREPARATION AND SPECTROSCOPIC STUDIES OF THE TERPYRIDYL COMPLEXES OF LIGHTER LANTHANIDES. Shyama P. Sinha (Cyanamid European Research Inst., Geneva). Z. Naturforsch., 20a: 552-60(Apr. 1965).

Rare earth-mono-terpyridyl complexes of the type M(Terp)Cl_3 • n H_2O (M = Ce – Gd, Terp = terpyridyl and n = 1 – 2.5) were prepared and their ultraviolet, visible, and infrared spectra were investigated. Probable assignments of the excited levels of the tripositive rare earths to the observed bands are given. The f → f transitions of the rare earths show red shift in the methanolic solution of the chelates with respect to the aquo ions. Definite indications of 4f → 5d transition of the Ce(III) and electron transfer band from the highest filled M.O. of the ligand to the partly filled 4f shell of Eu(III) and possibility of the same in case of Pr(III), Nd(III), and Sm(III) were obtained. The infrared studies of the solid chelates strongly suggest the coordinated nature of the terpyridyl molecule. Some infrared bands of the chelates show shift towards higher wave-number and lowering of intensities compared to the free ligand. Of particular interest is the pyridine ring breathing vibration of terpyridyl at 988 cm^{-1} which shows a shift of ~25 cm^{-1} in the chelates. The out-of-plane in-phase C–H deformation band at 830 cm^{-1} of terpyridyl shows considerable decrease of intensity in the chelates. (auth)

30194 X-RAY SPECTRAL ANALYSIS OF THE VALENCE STATES OF RARE EARTH ATOMS IN HEXABORIDES. E. E. Vainshtein, S. M. Blokhin, M. N. Bril, I. B. Staryl, and Yu. B. Paderno (Inst. of Inorganic Chemistry, Academy of Sciences, Siberian SSR, Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukranian SSR, and Odessa Pedogogical Inst.). Zh. Neorgan. Khim., 10: 121-6(Jan. 1965). (In Russian)

The x-ray absorption (L_{III}) spectra of the oxides and hexaborides of Nd, Pr, Ce, Gd, Eu, Yb, and Sm are presented, and hyperfine structures of the SmB_6 and EuB_6 absorption spectra and data on the energy absorption of their maxima are tabulated. Comparison of earlier reported data for La with the spectra of Nd, Pr, Ce, and Gd hexaborides showed a similarity among them. Within

the limits of error of the measurements, the maximum long-wave absorption lines coincide with those in the spectra of the rare earths in the corresponding oxides of the trivalent metals. The short-wave maxima differ, because their nature is dependent on the dispersion of electron waves in surrounding atoms. The location of the relative intensity of the maxima differs in the hexaborides and oxides and indicates a difference in the crystal structures. The Eu and Yb hexaboride long-wave maxima are both displaced 8 ev in comparison with the corresponding trivalent oxide, indicating a valence of less than 3 in the hexaborides. The Sm absorption spectrum in SmB_6 is unique. The long-wave absorption lines of the oxide and hexaboride coincide with those of EuB_6, but a 7-ev-displaced line also appears in SmB_6. (TTT)

30195 ON CERTAIN THORIUM COMPLEXONATES. D. I. Ryabchikov and M. P. Volynets. Zh. Neorgan. Khim., 10: 619-27(Mar. 1965). (In Russian)

By the method of high-frequency and potentiometric titrations, it was established that the complexing agents studied (ethylenediamine-bis-o-oxyphenylacetic acid, N,N′(bis-oxyphenyl)ethylenediamine-N,N′-diacetic acid, N-β-oxyethylethylenediamine-N,N′, N′ triacetic acid(I), ethylenediamine tetraacetic acid, and diethylenetriamine pentaacetic acid(II)) form, with thorium, complex compounds with the composition 1:1. The complex formations of COOH groups (with separated hydrogen ions) together with the OH groups of some of the complexones were studied. By the method of ion exchange chromatography the stability constants of thorium complexes with I (pH 3) and II (pH 2) were determined to be $5.78 \pm 0.12 \times 10^{-20}$ and $4.6 \pm 0.3 \times 10^{-31}$, respectively (at $\mu = 0.1$ and $t = 20 \pm 1°C$). (tr-auth)

30196 THERMAL STABILITY OF SCANDIUM SULFATES AND THEIR SOLUBILITY IN SULFURIC ACID SOLUTIONS AT 25°C. L. N. Komissarova, V. M. Shatskii, and G. I. Moiseichenko (Moscow State Univ.). Zh. Neorgan. Khim., 10: 755-63(Apr. 1965). (In Russian)

The thermal stability of the pentahydrate and anhydride of scandium sulfate was investigated in air by thermal, gravimetric, and x-ray analysis. It was established that the pentahydrate is completely dehydrated in the temperature interval from 110 to 260°C. The removal of water takes place in several stages with formation of stable dihydrates. Above 600°C $Sc_2(SO_4)_3$ decomposes to Sc_2O_3. The density, optical characteristics, and the index of refraction of $Sc_2(SO_4)_3 \cdot 5H_2O$ were determined. The solubility in the system $Sc_2SO_3)_3-H_2SO_4-H_2O$ was determined at 25°C at H_2SO_4 concentrations from 0 to 37.61N. In dependence on the H_2SO_4 concentration the existence of the following phases was established: $Sc_2(SO_4)_3 \cdot 5H_2O$ (20.68 to 40.32 wt % SO_3), $Sc_2(SO_4)_3$ (41.93 to 70.00 wt % SO_3), and $Sc_2(SO_4)_3 \cdot 3H_2SO_4$ (71.00 to 80.03 wt % SO_3). With the increase of the concentration of H_2SO_4, the solubility of the scandium sulfate was decreased. The maximum value of the solubility of $Sc_2(SO_4)_3 \cdot 5H_2O$ in water was 156.0 mg/l ml Sc_2O_3. The distribution of admixtures Th, Y Yb, Zr, Fe, Al, and Mn was investigated by precipitation of $Sc_2(SO_4)_3 \cdot 5H_2O$ and $Sc_2(SO_4)_3$ from sulfuric acid solution. It was established that the precipitation of $Sc_2(SO_4)_3 \cdot 5H_2O$ by the acidification of the solutions can be used for the purification of scandium from Zr and the rare earth elements and partially from thorium with scandium sulfate yields of ~50%. (tr-auth)

30197 COMPLEX COMPOUNDS OF RARE EARTHS WITH 1,10-PHENANTHROLINE. N. N. Lobanov and V. A. Smirnova (Inst. of Chemistry, Academy of Sciences, Moldavian SSR). Zh. Neorgan. Khim, 10: 840-3(Apr. 1965). (In Russian)

The series of previously unknown complex compounds of 1,10-phenanthroline with nitrate and sulfates of Eu, Gd, Tb, Dy, Ho, Er Tm, Yb, and Lu was prepared. The compounds were found to be $Eu(NO_3)_3 \cdot 2phen$, $Eu_2(SO_4)_3 \cdot 2phen \cdot H_2O$, $Gd(NO_3)_3 \cdot 2phen$, $Gd_2(SO_4)_3 \cdot 2phen \cdot 2H_2O$, $Tb(NO_3)_3 \cdot 2phen$, $Tb_2(SO_4)_3 \cdot 2phen \cdot 2H_2O$, $Dy(NO_3)_3 \cdot 2phen$, $Dy_2(SO_4)_3 \cdot 2phen \cdot H_2O$, $Ho(NO_3)_3 \cdot 2phen$, $Ho_2(SO_4)_3 \cdot 2phen \cdot 2.5H_2O$, $Er(NO_3)_3 \cdot 2phen$, $Er_2(SO_4)_3 \cdot 2phen \cdot 3H_2O$, $Tm(NO_3)_3 \cdot 2phen$, $Tm_2(SO_4)_3 \cdot 2phen \cdot H_2O$, $Yb(NO_3)_3 \cdot 2phen$, $Yb_2(SO_4)_3 \cdot 3phen \cdot 5H_2O$, $Lu(NO_3)_3 \cdot 2phen$, and $Lu_2(SO_4)_3 \cdot 3phen \cdot 4H_2O$. (tr-auth)

30198 THERMOCHEMISTRY OF FORMATION OF COMPLEXES OF RARE EARTH AND YTTRIUM IONS WITH ETHYLENEDIAMINETETRAACETATE. V. A. Korobova and G. A. Prik. Zh. Neorgan. Khim., 10: 844-52(Apr. 1965). (In Russian)

Calorimetric measurements were made of the thermal effects of mixed solutions of $Ln(NO_3)_3$ (Ln = Ce, Pr, Eu, Dy, Ho, Er, Yb, Lu, and Y) and trilon B at pH > 3. The thermal effects and the changes of the entropy of formation of the ethylenediaminetetraacetate complexes were calculated as $CeFDTA^-$ -4.8 ± 0.2 and 53, $PrEDTA^-$ -4.7 ± 0.1 and 55, $EuEDTA^-$ -3.5 ± 0.2 and 63, $DyEDTA^-$ -3.0 ± 0.3 and 69, $HoEDTA^-$ -3.1 ± 0.2 and 71, $ErEDTA^-$ -3.0 ± 0.2 and 72, $YbEDTA^-$ -2.7 ± 0.2 and 76, $LuEDTA^-$ -3.2 ± 0.2 and 75, and $YEDTA^-$ -1.6 ± 0.2 and 73, respectively. On the basis of the theory of ligand fields, the regularity observed in the changes of the thermal effects of the formation of the EDTA rare earth complexes was examined. Differences were detected in the behavior of the cerium and yttrium subgroups. (tr-auth)

30199 REACTIONS OF AMMONIUM HYDROXIDE WITH URANYL NITRATE AND SULFATE. N. I. Pechurova, L. M. Kovba, and E. A. Ippolitova. Zh. Neorgan. Khim., 10: 918-22(Apr. 1965). (In Russian)

During the action of ammonia on solutions of uranyl sulfate (200 g/l), double uranyl ammonium sulfate was precipitated; from less concentrated solutions (100 g/l), simultaneously with the primary salt ammonium uranate was precipitated; from solutions of uranyl nitrate (100 and 200 g/l) uranate phases were precipitated. The structure of the primary uranyl ammonium sulfate was close to the zippeite structure. Washing of the sedimentation of the primary uranyl ammonium sulfate with water led to the formation of ammonium uranate, close to the tetrauranate in composition. The primary uranyl ammonium sulfate was completely dehydrated at 350°C with simultaneous destruction of the original structure. After heating to 510°C, uranous oxide–uranic oxide was formed, possibly together with amorphous uranyl sulfate which decomposed around 760°C. Ammonium tetrauranate completely lost its water and partially ammonia at 250°C. Rhombic deformations of the hexagonal uranate cell arose. At 400 to 450°C β-UO_3 was formed which then decomposed to U_3O_8 (600°C). In argon currents, almost complete decomposition of the ammonium tetrauranate occurred at 350°C with formation of amorphous compounds, from which uranous oxide–uranic oxide results. The decomposition of ammonium uranate in reducing atmosphere (ammonia) proceeded in three stages: formation of amorphous products, U_3O_8, and fluorite phases of U_4O_9 or UO_{2+x}. (tr-auth)

30200 EFFECTS OF SOME NATURAL NEUTRAL LIGANDS ON THE PROPERTIES OF COMPLEX URANYL COMPOUNDS. S. M. Sinitsyna and N. M. Sinitsyn. Zh. Neorgan. Khim., 10: 923-6(Apr. 1965). (In Russian)

On the basis of the investigation of the reaction of intraspheric substitution, sequence of the displacing capacity of neutral oxygen-containing ligands was determined for complex uranyl compounds. It was found that the increase of the displacing capacity of the ligands leads to the reduction and to very stable U–O bonds (from UO_2). Thermograviograms of nitrate and chloride uranyl complexes were obtained. It was observed that the increase of the capacity of the ligands agrees with the increase of the thermostability of the complex compounds produced. (tr-auth)

30201 REACTIONS OF THORIUM NITRATE WITH ANIONS OF META- AND PARA-OXYBENZOIC ACID IN AQUEOUS SOLUTIONS. K. N. Kovalenko and D. V. Kazachenko (Rostov-on-Don State Univ., USSR). Zh. Neorgan. Khim., 10: 927-33(Apr. 1965). (In Russian)

The systems thorium nitrate–sodium m-oxybenzoate–water and thorium nitrate–sodium p-oxybenzoate–water were investigated. The electric conductivity, pH, and ion concentration of Th in the liquid phase of the systems were

measured. It was found that the thorium nitrate interacts with sodium m- and p oxybenzoate as well as with sodium salicylate, i.e., in exchange reactions in the mole ratio 1:4, in which two oxybenzoate ion are bound with thorium atoms. Chemical and thermographic analyses of thorium m- and p-oxybenzoate were made and some considerations on the structure of their molecules were found. (tr-auth)

30202 REACTIONS OF GADOLINIUM AND DYSPROSIUM CHLORIDES WITH MELTED SODIUM AND POTASSIUM CHLORIDES. B. G. Korshunov and D. V. Drobot (Inst. of Fine Chemical Tech., Moscow). Zh. Neorgan. Khim., 10: 939-42(Apr. 1965). (In Russian)

By the method of thermal analysis, the interaction of the components in the systems $GdCl_3-MeCl$ and $DyCl_3-MeCl$ (Me = Na and K) was investigated. Fusibility diagrams were constructed for the systems. In the $GdCl_3-NaCl$ system, one incongruently melting chemical compound, Na_3GdCl_6, was formed. In the system $GdCl_3-KCl$ one incongruently melting compound with the composition K_2GdCl_5 and two congruently melting compounds KGd_3Cl_{10} and K_3GdCl_6 were formed. In the system $DyCl_3-NaCl$ two incongruently melting compounds, $NaDy_3Cl_{10}$ and Na_2DyCl_6, were produced. In the system $DyCl_3-KCl$ congruently melting compounds of analogous composition were formed. Pycnometric densities for all compounds found or their pycnometric modifications were determined. Calculations of the liquidus lines for crystallizations from melts were made. For all the systems investigated the most probable composition of the complex is $(RCl_6)^{3-}$, where R is the rare earth element. (tr-auth)

30203 REACTIONS OF THORIUM AND RARE EARTHS WITH TARTARIC ACID. O. E. Zvyagintsev and V. P. Tikhonov (Mendeleev Inst. of Chemical Engineering, Moscow). Zh. Neorgan. Khim., 10: 994-6(Apr. 1965). (In Russian)

The interaction of thorium and rare earths with tartaric acid during their common occurrence was investigated. It was found that at the ratio $\Sigma Th,R.E. : H_4Tar = 1:1.5$ and at pH 4 thorium can go into solution, but the rare earths remain in the precipitate. (tr-auth)

30204 HYDROLYSIS OF Ce(III) IN NITRIC ACID SOLUTIONS BY ELECTROMIGRATION METHOD. A. V. Stepanov and V. P. Shvedov. Zh. Neorgan. Khim., 10: 1000-2(Apr. 1965). (In Russian)

It was proven that mononuclear hydroxycomplexes of the type $(Ce(OH)_n)^{3-n}$ predominate in acid solutions only at Ce concentrations not exceeding 10^{-5} mole/l. For higher concentrations of the metal the formation of the polynuclear form begins. The existence of the complex $(Ce(OH))^{2+}$ and its stability constant was determined to be equal to $4.5 \pm 2.5 \times 10^9$ ($\mu = 0.005$, t = 25°C). (tr-auth)

30205 PREPARATION AND PROPERTIES OF Ce(III) SODIUM SALT WITH ETHYLENEDIAMINETETRAACETIC ACID. N. P. Kusakina and E. M. Yakimets. Zh. Neorgan. Khim., 10: 1010-12(Apr. 1965). (In Russian)

The conditions for the formation of the sodium salt of Ce(III) with ethylenediaminetetraacetic acid were investigated. The composition of the salt was established; its crystallographic and magnetochemical properties were investigated; infrared spectra were obtained; and the thermal stability and solubility in water were determined. (tr-auth)

30206 PREPARATION AND PROPERTIES OF Ce(III) HYDROGEN COMPOUNDS WITH ETHYLENEDIAMINETETRAACETIC ACID. N. P. Kusakina and E. M. Yakimets. Zh. Neorgan. Khim., 10: 1013-14(Apr. 1965). (In Russian)

The conditions for the formation of hydrogen compounds of Ce(III) with ethylenediaminetetraacetic acid were investigated and its composition was established. The solubility of $HCeY \cdot 2H_2O$ was determined and dissociation constants of the acid were calculated. The thermal stability of the compound was investigated, and the infrared spectrum was obtained. (tr-auth)

30207 OPTICAL PROPERTIES OF RARE EARTH OXIDES. III. POLYTHERMAL INVESTIGATION OF Eu_2O_3 AND Er_2O_3. S. S. Batsanov, K. F. Obzherina, and E. D. Ruchkin. Zh. Strukt. Khim., 6: 310-13(Mar.-Apr. 1965). (In Russian)

Optical and chemical studies were made of Eu and Er oxalates with refractive indices and densities $n_g = 1.625$, $n_p = 1.485$, and $d_f^{25} = 2.52$ g/cm^3 and $n_g = 1.628$, $n_p = 1.481$, and $d_f^{25} = 3.06$, respectively. Refractometric constants were measured at 500 to 1200°C. Eu and Er oxalates transformed into oxides at 700 to 800°C. The measured densities $d_{Eu_2O_3} = 7.27$ and $d_{Er_2O_3} = 8.65$ were in agreement with published data. Refractive indices for the monoclinic Eu_2O_3 modification were similar to Sm_2O_3 ($n_g = 2.095$, $n_m = 2.093$, and $n_p = 2.070$). Polymorphous transition of Eu_2O_3 began at 1100 and ended at 1100°C. The molar refraction of Er_2O_3, annealed at various temperatures, remained constant (~21.7 ± 0.15 cm^3). The molar refraction of Eu_2O_3 at 500 to 1200°C was equal to 24.2 ± 0.2 cm^3; at 1200°C it decreased to 22.8 cm^3. Spectrograms of Eu and Er oxalates indicated that at 1300 to 1500 cm^{-1} the respective C–O bonds disappear at 700 to 800°C. The tabulated data on the intensity of the absorption band and optical density did not vary at temperatures from 900 to 1200°C at 1350°C values diminished 6 to 7% and dropped sharply in remelted specimens. (R.V.J.)

30208 PROCESS FOR THE PRODUCTION OF BASIC ZIRCONIUM SULPHATE. (to Deutsche Gold-Und Silber-Scheideanstalt). British Patent 979,393. Jan. 1, 1965. Priority date Oct. 26, 1961, Germany.

A process for the production of basic zirconium sulfate consists of treating an alkali metal zirconium silicate with hydrochloric acid followed by 0.55 to 0.6 moles of sulfuric acid per mole of zirconium dioxide in the zirconium silicate. The acidified solution is heated for 2 hours at 90 to 110°C before the precipitated silica is removed by filtration. The precipitated silica is washed with an aqueous solution containing 4 wt % NaCl and 1 wt % HCl. After separation of the silica, the filtrate is neutralized and kept cool for 1 hour and then heated slowly to 100°C to precipitate a coarse-grained product or heated rapidly to 95 to 100°C immediately after neutralization to produce a fine-grained basic zirconium sulfate. (B.L.M.)

30209 IMPROVEMENTS IN SOLS CONTAINING ACTINIDE METALS. (to W. R. Grace and Co.). British Patent 980,125. Jan. 13, 1965. Priority date Feb. 27, 1962, United States.

Methods are described for the preparation of sols of particles of one or more of the rare earths and one or more oxides of U(IV), Pu, or an element of atomic number greater than Pu. A freshly prepared sol of rare earth oxide and actinide metal oxide may be prepared either by peptizing the corresponding hydroxide with a non-oxidizing monobasic acid, preferably acetic acid, or by removing the anions from a solution of a salt of the element, usually the chloride, by electrodialysis or ion exchange. The peptization is generally carried out at an elevated temperature of 40 to 100°C for at least 1 hour. When the two sols are mixed, they must still be in the freshly prepared, active state. The sols are then autoclaved at a temperature of at least 100 to 300°C for a period of 1 to 40 hours. The autoclaving is carried out under an inert atmosphere, and the sol is then deionized and concentrated by centrifuging, decanting, and redispersing in deionized water. The particles in the sols are generally from 5 to 100 mμ in size. (B.L.M.)

30210 PROCESS FOR THE REDUCTION OF URANIUM HEXAFLUORIDE TO URANIUM TETRAFLUORIDE. (to Univ. of Melbourne). British Patent 983,036. Feb. 10, 1965. Priority date Aug. 17, 1962, Australia.

A process is reported for the gaseous phase reduction of UF_6 to UF_4 by reaction with PF_3. The molar proportions of UF_6 to PF_3 are in excess of 1:1, and an intermediate fluoride of U is produced at the reaction temperature of below 150°C. The intermediate fluoride is decomposed to UF_4 by heating at a temperature of 100–300°C. Hydrogen fluoride may also be introduced into the gaseous reaction mixture with molar proportions of HF to PF_3 between 1:1 and 1:20. (B.L.M.)

30211 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR THE PREPARATION OF TETRAVALENT URANIUM SALTS. (to European Company for the Chemical Processing of Irradiated Fuels). British Patent 983,889. Feb. 17, 1965. Priority date Sept. 1, 1961, Belgium.

A process for the preparation of water-soluble U(IV) salts consists in reducing a U(VI) salt in acid solution, adjusting the pH of the solution to precipitate U(IV) hydroxide, and dissolving the hydroxide in an acid to yield the corresponding U(IV) salt. To obtain the U(IV) salt in crystalline form, the solution is evaporated in vacuum. The reduction of the U(VI) is effected by the use of a metal that forms an amphoteric hydroxide, by an alkaline salt of methanesulfinic acid, or electrolytically. (B.L.M.)

30212 MASSIVE CRYSTALS OF U_3O_8. Donald E. Rhodes (to Kerr-McGee Oil Industries, Inc.). U. S. Patent 3,167,388. Jan. 26, 1965. Filed Apr. 26, 1961.

A process is described for the preparation of crystals of U_3O_8 of a particle size of about 3000 to 13000 μ. A compound of uranium is melted, and the temperature of the molten mass is maintained above 2200°C to convert the melt to substantially UO_2. The melt of UO_2 is cooled to 950 to 1150°C and maintained there until the UO_2 is converted to massive crystals of U_3O_8. Alternatively, the molten UO_2 may be cooled to room temperature in a non-oxidizing atmosphere to form large crystals of UO_2, and then oxidized to U_3O_8 while maintaining the temperature in the range of 950 to 1150°C. (B.L.M.)

30213 XENON HEXAFLUORIDE AND METHOD OF MAKING. John G. Malm, Irving Sheft, Cedric L. Chernick, and Harold H. Claassen (to U. S. Atomic Energy Commission). U. S. Patent 3,192,016. June 29, 1965.

A process for preparing xenon hexafluoride that comprises heating xenon gas and at least 10 moles of fluorine gas per mole of xenon in a closed system to between 200 and 400°C is described. (AEC)

Organic Chemistry

Refer also to abstract 30655.

30214 TECHNIQUE FOR INCORPORATING WATER-SOLUBLE TRACERS IN HYDROCARBON MEDIA. William C. Tosch (Marathon Oil Co., Littleton, Colo.). Anal. Chem., 37: 958(June 1965).

A method was devised for dispersing a water-soluble tracer in hydrocarbons by a secondary solubilization phenomenon. An aqueous solution containing the tracer is solubilized or emulsified by a hydrocarbon-surfactant solution. This emulsion is then added to the hydrocarbon to be tagged. (M.C.G.)

30215 FORMATION CONSTANTS OF COMPLEXES OF 2-THENOYLTRIFLUOROACETONE AND 3-THENOYLACETONE. Joseph L. Rosenstreich and David E. Goldberg (City Univ. of New York, Brooklyn). Inorg. Chem., 4: 909-10(June 1965).

Studies were made to determine whether the TTA ligand might be terdentate in nature. Average formation constants for the first and second coordination steps were determined for the ligand with Cu(II) and Ni(II) ions. Constants were also determined for 3-thenoylacetone for comparison to the data for 2-TTA. 2-TTA was found to be a bidentate ligand, at least in its coordination with Cu(II) ion. It is also likely that the sulfur of 2-TTA does not coordinate. Data are tabulated. (P.C.H.)

30216 THE PREPARATION OF TRITIATED DINITROFLUOROBENZENE OF HIGH SPECIFIC ACTIVITY. T. Hesselbo (Roche Products Ltd., Welwyn Garden City, Herts, Eng.). Intern. J. Appl. Radiation Isotopes, 16: 329-31(May 1965).

The preparation of 2,4-dinitrofluorobenzene-3,5-^{3}H with a specific activity of approximately 19 C/mM is reported. Tritium gas was mixed with 1-bromo-3-fluorobenzene to produce fluorobenzene-3,5-^{3}H. Nitric acid was mixed with the fluorobenzene-3,5-^{3}H to produce the 2,4-dinitrofluorobenzene-3,5-^{3}H. The product had a radiochemical purity of 88%. The purity of the compound was checked by thin-layer chromatography. (M.C.G.)

30217 APPLICATION OF TAFT'S FLUORINE-19 CHEMICAL SHIFT CORRELATIONS TO THE STUDY OF SECONDARY DEUTERIUM ISOTOPE EFFECTS. Gary E. Maciel (Univ. of California, Davis) and Daniel D. Traficante. J. Am. Chem. Soc., 87: 2508-9(June 5, 1965).

Attempts were made to detect isotope effects on the separate inductive and resonance σ constants of the methyl group by utilizing Taft's correlations of these constants with the ^{19}F chemical shifts of p- and m-substituted fluorobenzenes. Therefore, p- and m-fluorotoluene – α,α,α-d_3 was prepared and their ^{19}F chemical shifts determined with respect to their undeuterated analogs. The ^{19}F nuclear magnetic resonance spectra of m-fluorotoluene and its deuterium – substituted analog gave nearly identical patterns indicating no chemical shift. For the para-compounds, the pattern of the spectra was complicated with overlapping peaks, consistent with the assumption of a chemical shift of the undeuterated compound about 0.7 ± 0.2 cps greater than that of the deuterated analog. Results indicated that $\Delta\sigma_I$ is zero and $\Delta\sigma_R$ is smaller than expected for the change in the substituent $CH_3 \rightarrow CO_3$. (M.C.G.)

30218 THE USE OF CHROMATOGRAPHIC PROCEDURES IN THE SYNTHESIS OF ^{14}C-LABELLED PHOSPHODIESTERS. Giuseppe Porcellati (Universita di Perugia, Pavia, Italy). J. Chromatog., 18: 168-9(Apr. 1965).

The use of ion-exchange and thin-layer chromatography in preparation of pure crystals of ^{14}C-labeled phosphodiesters is discussed. Chromatography was found to be a simple, rapid method for purification of the labeled compounds. (M.C.G.)

30219 POTENTIAL RADIATION-PROTECTIVE AGENTS. IV. SULFUR ANALOGS RELATED TO NOREPHEDRINE. K. Venkatramana Bhat and Walter C. McCarthy (Univ. of Washington, Seattle). J. Pharm. Sci., 54: 488-9(Mar. 1965).

In the continuation of work reported previously on mercapto analogs related to ephedrine, similar analogs corresponding to norephedrine were investigated. dl-Norephedrine reacted with thionyl chloride to produce 2-amino-1-chloro-1-phenylpropane-HCl. This salt was converted to the free base, and its reaction with two different sulfur nucleophiles was studied. Upon reaction of the free base with K ethyl xanthate, cyclization occurred to produce 4-methyl-5-phenyl-thiazolidine-2-thione. Upon condensation of the free base with sodium thioacetate, migration of the acetyl group from S to N occurred to produce 2-acetamido-1-mercapto-1-phenylpropane. During isolation, the mercaptan was partly air-oxidized to the corresponding disulfide. Hydrolysis of the acetyl group of bis-(2-acetamido-1-phenyl-1-propyl) disulfide was hindered, but it could be forced under drastic conditions. The amide was recovered unchanged after refluxing for 6 hr in a mixture of 30 ml of ethanol and 20 ml of concentrated HCl. The amide group was cleaved, however, by refluxing for 48 hr in concentrated HCl. Originally, bis-(2-amino-1-phenyl-1-propyl) disulfide-2 HCl was obtained, but because solvent of crystallization gave difficulty in securing a satisfactory analytical sample, this compound was converted through the free base to the HBr salt. Experimental details for preparation are given, as well as some of their properties, but no data relating to their radioprotective activity are provided. (BBB)

30220 CONVERSIONS OF FIVE- AND SIX-MEMBERED CYCLENES ON RARE-EARTH OXIDES. Kh. M. Minachev. Neftekhimiya, 1: 356-61(May-June 1961). (In Russian)

The catalytic conversion of the cyclohexenes 1-methyl-1-cyclopentene and 1-methyl-1-cyclohexene was investigated on the catalysts Er_2O_3 and Nd_2O_3 in the temperature range from 330 to 530°C. It was found that both catalysts could produce dehydrogenation of the six-membered cyclene to the corresponding aromatic hydrocarbons and transfer of

the double bonds to five- and six-membered rings. The thermal limits of the beginning of the transfer reaction of the double bonds and dehydrogenation were determined for the five- and six-membered cyclenes. (tr-auth)

30221 OBTAINING KETONES IN THE PRESENCE OF NEODYMIUM AND ERBIUM OXIDES. M. B. Turova-Polyak, Khoant Chong Iem, and I. E. Svsnina. Neftekhimiya, 4: 603-8(July-Aug. 1964). (In Russian)

The catalytic activity of the oxides of Nd and Er on different carriers was investigated in reactions for the preparation of ketone from acid in the vapor phase at atmospheric pressure. The effects of the method of preparation of the catalyst, composition of the acid, and the conditions of the reactions studied on the ketone yield were investigated. The possibility of preparing aliphatic symmetrical and nonsymmetrical ketones using Nd_2O_3 and Er_2O_3 catalysts was established. The conditions at which the ketone yields reach 80 to 90% were found. (tr-auth)

30222 DEHYDROGENATION OF CYCLOHEXANE ON OXIDES OF RARE EARTH ELEMENTS. Kh. M. Minachev. Neftekhimiya, 1: 489-93(1961). (In Russian)

The dehydrogenation of cyclohexanes on La_2O_3, Nd_2O_3, Sm_2O_3, Gd_2O_3, Ho_2O_3, Fr_2O_3, Tm_2O_3, Yb_2O_3, and Y_2O_3 was investigated at temperatures from 515 to 590°C. For all the oxides studied a comparison was made of their general and specific catalytic activities. It was found that with respect to their general activities they were arranged in the following sequence: Tm > Yb > Er > Ho > Gd > Sm > Nd > La, whereas with respect to their specific activities the yttrium group surpassed the oxides of the Ce group. (tr-auth)

30223 INFRARED ABSORPTION SPECTRA OF DL-LYSINE MONOHYDROCHLORIDE AND DIHYDROCHLORIDE, AND ^{15}N ISOTOPE EFFECTS. Asao Nakamura (Ajinomoto Co., Inc., Kawasaki-shi, Japan). Nippon Kagaku Zasshi, 86: 500-5(May 1965). (In Japanese)

Mono- and dihydrochlorides of DL-lysine-α-^{15}N and DL-lysine-α, ϵ-$^{15}N_2$, and dihydrochlorides of tetramethylenediamine-α, δ-$^{15}N_2$ and pentamethylenediamine-α, ϵ-$^{15}N_2$ were synthesized from ammonium-^{15}N sulfate. The vibrational frequencies of these compounds are discussed in terms of the observed frequencies of the infrared absorption spectra and their ^{15}N isotope shifts in the spectral region from 1750 to 650 cm^{-1}. The assignments of the absorption bands due to the α-NH_3^+ and ϵ-NH_3^+ symmetric deformation vibrations of DL-lysine monohydrochloride and dihydrochloride were established by observing the spectra of both α-^{15}N- and α,ϵ-^{15}N-compounds. (auth)

30224 SPIN-LATTICE RELAXATION IN DEUTERATED METHANES. N. J. Trappeniers, C. J. Gerritsma, and P. H. Oosting (Universiteit, Amsterdam). Physica, 31: 202-4 (Feb. 1965).

The proton spin-lattice relaxation time T_1 of CH_4, CH_3D, CH_2D_2, and CHD_3 was measured as a function of temperature, using a spin echo spectrometer. A 90°-90° pulse sequence at a working frequency of 28.8 MH_2 was employed. The range of measurements included the solid from 77°K to the triple point (90.66°K) and the liquid-gas coexistence region to the vicinity of the critical point. A new technique was evolved to remove all traces of O_2 from the samples, whereby O_2 is reduced in a solution containing Cr^{++} ions. Results are plotted. The behavior of T_1 in the gas phase at constant density was investigated also. (M.H.R.)

30225 REPORT OF THE KINETICS OF THE CATALYTIC DECARBOXYLATION OF CARBOXYLIC ACIDS IN HETEROGENEOUS PHASES AND DETERMINATION OF KINETIC ISOTOPE EFFECTS $^{12}C-^{14}C$. M. Roesseler and H. Koch (Inst. for Applied Radioactivity, Leipzig). Radiochim Acta, 4: 12-17(May 1965). (In German)

The velocity constants of the catalytic decarboxylation of benzoic acid, m-nitro- and m-dinitro-benzoic acid, and phenylacetic acid were determined, and activation energies calculated. From the relative specific activities of starting material (with ^{14}C-labeled carboxyl groups) and products, and from the conversion ratio, the kinetic isotope effect k_{12}/k_{14} can be calculated. The activation energy of decarboxylation at 238°C, with quinoline and copper oxide as catalysts, parallels the isotope effect, from which a substituent effect on the latter was derived. The theoretical k_{12}/k_{14} was 1,057. The difference between experimental and theoretical isotope effects was attributed to catalysis by the quinoline, and to insufficient calculation methods. (auth)

30226 HYDROGEN AND DEUTERIUM ATOM ABSTRACTION FROM METHYLAMINE AND DEUTERATED METHYLAMINES: KINETIC ISOTOPE EFFECTS AND RELATIVE REACTIVITIES OF THE METHYL AND AMINE GROUPS. Peter Gray and J. C. J. Thynne (Leeds Univ., Eng.). Trans. Faraday Soc., 59: 2275-86(Oct. 1963).

To determine the position of methyl radical attack, a study was made of hydrogen abstraction from methylamine, trideuteromethylamine, and methylamine-d_2, the results of which also enable the kinetic isotope effects to be assessed and compared with those investigated in other members of the CH_3X series (ethane, methylamine, methanol, and methyl fluoride). Radical attack was found to occur both at the carbon and at the nitrogen atom; over the temperature range (120-175°C) studied, the rate of H-abstraction from the amine group was greater than from the methyl group. Substitution of D for H did not preceptibly alter the reactivity of other atoms in the molecule (zero secondary isotope effect); the relative reactivities of H and D (primary isotope effect) are in accord with zero-point-energy differences. The Arrhenius parameters (based on a value $10^{13.34}$ cm^3 $mole^{-1}$ sec^{-1} for the recombination of methyl radicals) for various reactions are tabulated. Relative to ethane, the rates of H abstraction at 150°C from the respective methyl groups in the series CH_3CD_3, CH_3NH_2, CH_3OH, and CH_3F are 1:150:50:600. There is thus a marked activation by all three polar groups, fluorine having the greatest effect. Comparison of the abstraction from the group X (X = CH_3, NH_2, or OH) in CH_3X shows the greater reactivity of the amine and hydroxyl groups. If velocity constants are expressed per H atom available, rates of abstraction at 150°C in the series ethane, methylamine, methanol are in the ratios 1:250:1110. The photolysis of azomethane was also studied, since it was used as the source of methyl radicals. Tetramethyl hydrazine and methyl ethyl di-imide were found among the products of its photolysis. (BBB)

30227 HYDROGENATION OF OLEFINS. PART 2. REACTION OF ETHYLENE WITH DEUTERIUM OVER ALUMINA-SUPPORTED RUTHENIUM AND OSMIUM. G. C. Bond, G. Webb, and P. B. Wells (Univ. of Hull, Eng.). Trans. Faraday Soc., 61: 999-1006(May 1965).

The reaction of ethylene with deuterium was studied using alumina-supported Ru and Os catalysts in a static system between 0 and 80°C with various ethylene and deuterium pressures; products were analyzed by mass spectrometry. Ethylene-d_1 constituted about one-half of the initial products over Ru, and ethane-d_2 was the predominant ethane: no ethylene-d_3 or -d_4 nor ethane-d_5 or -d_6 was formed over this metal. Olefin exchange was less marked over Os, ethylene-d_1 constituting 15 to 30% of the initial products: ethane-d_2 was again the predominant ethane but all other deuterated ethanes were observed. Rates of hydrogenation were proportional to P_{D_2} over both metals: the activation energy for hydrogenation was ~8.5 kcal $mole^{-1}$ with both metals, and for hydrogen exchange and/olefin exchange ~12 kcal $mole^{-1}$. Product distributions were compared with those calculated previously and the reversion of an ethyl radical into adsorbed ethylene and a hydrogen atom was seen to be less favored than with Pt and Ir but ethylene desorption much easier. The ethyl radical coverage did not increase with P_{D_2} as expected from previously proposed mechanisms, and a possible modification was proposed. (auth)

Radiation Chemistry

See also BIOLOGY AND MEDICINE — Radiation Effects.

30228 (CRC-1219) THE RADIOLYSIS OF ORTHO AND META TERPHENYL. I. WITH A MIXTURE OF FAST

NEUTRONS AND GAMMA RAYS AT DOSE RATES OF 0.1 AND 0.3 Wg^{-1}. A. W. Boyd and H. W. J. Connor (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1965. 30p. (AECL-2258) Dep.; $0.50(AECL)

Ortho and meta-terphenyl were irradiated at dose rates of 0.1 and 0.3 w/g inside annular fuel elements at temperatures from 100 to 450°C. Half the energy absorbed was due to fast neutron scattering and half to gamma ray absorption. Disappearance, high boiler, benzene and biphenyl yields and total gas and hydrogen yields were determined. The disappearance yields for ortho-terphenyl increased from 0.4 at 100 to ~4 at 450°C. The disappearance yields for meta-terphenyl and the high boiler yields for both compounds increased from 0.4 at 100 to ~1.5 at 450°C. Benzene and biphenyl yields increased 30 to 100 fold over the same range. No dependence on dose rate was observed. Prior irradiation was found to increase the pyrolytic decomposition rate of meta-terphenyl but not that of ortho-terphenyl. (auth)

30229 (JAERI-4031) SURVEY ON GAMMA-RAY INDUCED POLYMERIZATION OF ETHYLENE. Masao Gotoda, Sueo Machi, Yasuo Yamamoto, Shuji Fujioka, Miyuki Hagiwara, and Tsutomu Kagiya (Japan Atomic Energy Research Inst., Tokyo). Dec. 1964. 114p. Dep. (mn). In Japanese.

The polymerizations of ethylene, including gamma-induced polymerization, are investigated and discussed with respect to basic research and industrial applications. Ethylene was first polymerized to the solid polymer in 1933, using the radical initiator at high pressure and temperature. Later in 1953, the Ziegler catalyst was developed as an effective catalyst for the low-pressure and -temperature polymerization. The radiation-induced polymerization, on the other hand, has been studied in the past ten years. The properties of the polyethylenes produced and the engineering aspects of the polymerizations are also described. (auth)

30230 (MATT-329) DECOMPOSITION OF MOLTEN LITHIUM NITRATE BY RADIATION. M. D. Kostin, R. C. Axtmann, and E. F. Johnson (Princeton Univ., N. J. Plasma Physics Lab.). May 1965. Contract AT(30-1)-1238. 17p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

High-energy neutrons produced by fusion reactions in proposed thermonuclear power reactors collide with nuclei of the surrounding coolant-breeder material. The transfer of kinetic energy from neutrons to nuclei which produces rapidly moving ions and atoms, and the subsequent atom-atom collisions which increase the number of energetic atoms are investigated, and an estimate of the total number of energetic atoms produced by a single fusion neutron moving in lithium nitrate is obtained. Approximate kinetic equations describing thermal and radiolytic decomposition are solved for conditions of continuous and intermittent irradiation. For anticipated operating conditions, the steady-state concentrations are found to be appreciably different from those at equilibrium in the absence of irradiation. It is also shown that the energy distribution of atoms in the epithermal region is considerably different from the equilibrium Maxwellian distribution. (auth)

30231 (MIT-334-12) IN-PILE LOOP IRRADIATION STUDIES OF ORGANIC COOLANT MATERIALS. Progress Report, October 1, 1963–December 31, 1964. E. A. Mason (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Feb. 1, 1965. Contract AT(38-1)-334. 32p. Dep.; $2.00(cy), 1(mn) CFSTI.

Irradiations of Santowax WR in the MITR at a fast neutron fraction of 40% at temperatures of 425 to 800°F have been completed. The irradiations were carried out with steady-state distillation processing and recycle of the coolant. Samples of degradation gases have been analyzed and the gas generation rate determined for the irradiation of Santowax WR. Analysis of the results on the decomposition of terphenyls using first-order kinetics indicates that the rate of pyrolysis of irradiated coolant is much greater than that of unirradiated coolant. The ratio of the first-order pyrolysis rate constant for irradiated coolant to the rate constant for unirradiated coolant varies with temperature but, for example, is approximately 10 at a temperature of 750°F. This indicates that the pyrolysis can have an important effect on the design and operation of organic-cooled reactor systems. A series of six measurements of dose rates by calorimetry have been carried out; some difficulty with the use of polyethylene as an energy absorber has been experienced. Nine measurements of the fast neutron flux at the irradiation facility have been made using a number of epithermal resonance and fast neutron threshold foils. (D.L.C.)

30232 (NP-15054) WPLYW PROMIENIOWANIA OPTYCZNEGO I WYSOKOENERGETYCZNEGO NA REAKCJE REDUKCJI I UTLENIANIA JONOW U(VI) I U(IV) W ROZTWORACH WODNYCH. (The Influence of Light (405 mμ) and γ Radiation on the Reduction and Oxidation of U(VI) and U(IV) Ions in Aqueous Solutions). Jerzy Sobkowski (Warsaw Univ. (Poland)). 1964. 127p. Dep.

Under the influence of light, U(VI) ions undergo reduction to U(V) ions, which disproportionate to U(IV) and U(VI). The course of reaction was indicated by the changes of potential of the platinum electrode, immersed in the solution containing U(IV) and U(VI). It was observed that the photoelectrochemical effect increased in the presence of complexing agents. The rate constants and the energies of U(V) disproportionation were determined in perchloric acid and in solutions containing sulfates, citrates, and tartrates. The presence of chloride ions decreased the influence of the complexing agents. The photoelectrochemical effect was hardly noticeable when using a platinized electrode. This fact was attributed to the promotion of the disproportionation of U(V). The experiments pointed out that the influence of the electrode surface depended also on the nature of the media used. The oxidation of U(IV) ions by γ radiation was investigated by the polarographic method. The vessel was placed directly in the γ source, that made it possible to observe the course of reaction during the irradiation. The yields of oxidation of U(IV) ions in relation to their concentration in the solution were determined. At the beginning of irradiation, the concentration of unstable U(V) ions increased linearly and after some time attained a stationary value. After the irradiation was discontinued, the concentration of U(V) decreased in consequence of disproportionation. On the basis of the obtained experimental data, a mechanism of oxidation of U(IV) ions by γ radiation is proposed. (auth)

30233 (ORNL-3789(p.318-22)) EFFECT OF RADIATION ON ORGANIC MATERIALS. W. W. Parkinson and O. Sisman (Oak Ridge National Lab., Tenn.).

Earlier findings of linear energy transfer (LET) effect in the irradiation of polystyrene were followed by measurements of free-radical yields by electron-spin-resonance techniques. Radical yields from gamma radiation and fast neutrons were equal within experimental error for a single series of specimens. The absolute yield was 0.12 ± 0.08 radical per 100 ev, with the large experimental error resulting from the uncertainty in the concentration of spins in the standard and from variations in the position of the standard within the electromagnetic field of the spectrometer. The equal radical yields from gamma radiation and fast neutrons contrast with the increased yields of cross links and volatile products at high LET and are difficult to reconcile with a mechanism based on second-order recombination reactions of the observed radicals in spurs. Flux mapping was performed on a 18,900-curie ^{60}Co source to provide calculation of doses to various specimens inside and outside the source. (J.R.D.)

30234 (ORO-628) PREPARATION OF WOOD-PLASTIC COMBINATIONS USING GAMMA RADIATION TO INDUCE POLYMERIZATION. James A. Kent, Anthony Winston, William R. Boyle, Wesley Loos, and Joseph E. Ayres (West Virginia Univ., Morgantown. Engineering Experiment Station). May 14, 1965. Contract AT(40-1)-2945. 112p. Dep.; $4.00(cy), 2(mn) CFSTI.

The reported work was directed at exploring additional polymer systems, refining the data on dose rate dependence of the polymerization reaction, incorporating studies of ad-

ditional species of wood into the program, and continuing the measurement of mechanical properties (including toughness and abrasion resistance, neither of which was previously investigated). The previously reported pattern of improvements in mechanical properties is substantiated by the reported studies. In connection with polymerization studies it was found that tough, continuous radiation polymers and copolymers of vinyl chloride can be prepared if suitable plasticizers are used. Also, radiation copolymers of styrene–acrylonitrile appear to be feasible for use in wood-plastic composites. Further studies involving carbon tetrachloride as a promoter for the radiation polymerization of methyl methacrylate showed that important reductions in radiation requirements are possible. A number of polymer dyes were investigated to determine their effects on the appearance of wood-plastic combinations. It was found that many of them accentuate the wood grain while at the same time imparting attractive colors to the wood. Data are presented which show that the dyes have inhibitory effects on the polymerization reaction and that such effects increase with dye concentration. However, at concentrations which are potentially useful for wood-plastic combinations, the inhibition is not sufficient to give cause for concern. Exploratory work with radiation polymers and copolymers of formaldehyde strongly indicated that such systems are not practical for use in wood-plastic combinations. (auth)

30235 (RPI-321-2) [PROGRESS REPORT ON RADIATION CHEMISTRY, NOVEMBER 1–DECEMBER 31, 1964]. S. Dondes (Rensselaer Polytechnic Inst., Troy, N. Y. Mason Lab.). Jan. 29, 1965. Contract AT(30-3)-321. 6p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Studies of ozone radiolysis using ^{210}Po alpha sources are reported. Production of C_3O_2 by reaction of P_2O_5 and malonic acid is described. Work toward determining whether radioinduced C_3O_2 has an intermediate is described. Evidence that irradiated CO polymers and C_3O_2 polymers are polymeric quinones is presented. Photolytic irradiation of CO at 10 atm. yielded a brown powder which is being prepared for analysis. Work on radioinduced isotopic exchange of N was continued. Nitrous oxide in which ^{15}N is incorporated was prepared. A program was written for analysis of ^{15}N mass spectra. Results of C_3O_2 decontamination by dissolution and precipitation and by ion exchange are discussed. The emission spectra from He-^{235}U-samples in the reactor light pipe experiment were observed. (J.R.D.)

30236 (TID-21683) RADIATION-INDUCED EMULSION POLYMERIZATION. Technical Progress Report, February 1–November 30, 1964. V. T. Stannett (Camille Dreyfus Lab., Research Triangle Inst., Durham, N. C.). Dec. 23, 1964. Contract AT(40-1)-2513. 32p. Dep.; $2.00(cy), 1(mn) CFSTI.

The present status of research in the field of radioinduced emulsion polymerizations is reviewed briefly, and plans for the issuance of a comprehensive review are presented. The preparation and properties of a number of polystyrene and polyvinyl acetate lattices are described. It is shown that the radiation products have somewhat narrower particle size and molecular weight distributions than the corresponding chemically initiated products. Polyvinyl acetate lattices of high molecular weight were prepared by radiation initiation at 0°C. The geometrical isomerism of polyisoprene and the tacticity of polymethyl methacrylate have been determined using IR and NMR, respectively. Polymers prepared by radiation at 0°C and 60°C showed only the expected changes due to temperature. (auth)

30237 (USNRDL-TR-843) THE RADIOLYTIC DECOMPOSITION OF MONOMETHYL-HYDRAZINE ROCKET FUEL. W. E. Shelberg (Naval Radiological Defense Lab., San Francisco, Calif.). Apr. 5, 1965. 18p.

The storability of monomethylhydrazine (MMH) with respect to solar cosmic, Van Allen belt, and nuclear rocket radiations cannot be improved by the addition of free-radical scavengers since the scavengers will fail to suppress the generation of off-gases in MMH by the radiations. This is shown by the inability of normally efficient, olefinic, free-radical scavengers (methyl methacrylate or pentadiene-1,3) to suppress the evolution of off-gas during gamma radiolysis. Accordingly, the radiolytic decomposition of MMH proceeds via a molecular or ionic reaction rather than a diffusion-controlled, free-radical reaction. Gamma radiolysis of a 100-ml specimen to 0.85×10^7 rads produces 227 ml of off-gas (25°C and 1 atm) which is nearly an equimolar mixture of hydrogen (38.7%), nitrogen (33.5%), and methane (27.8%). The average radiation yields (molecules/100 ev) of these gases are 4.7, 4.0, and 3.4, respectively. The presence of carbon tetrachloride as a free-radical scavenger in MMH increases the nitrogen and methane radiation yields to approximately 30 (a value which is typical of a chain reaction) but does not alter the hydrogen yield significantly. This behavior is attributed to the simultaneous occurrence of two major reactions. One is the aforementioned molecular or ionic reaction that occurs in unadulterated MMH. It produces the expected, nearly equivalent yields of hydrogen, nitrogen, and methane. It accounts for all of the hydrogen gas observed in the radiolysis but does not account for all of the nitrogen and methane gases. The other reaction is a chain reaction initiated by the carbon tetrachloride. It produces no hydrogen gas, but produces typically large yields of nitrogen and methane gases. The proposed chain propagating steps are as follows: $\cdot CCl_3 + CH_3NHNH_2 \rightarrow CHCl_3 + N_2 + CH_4 + H\cdot$ and $H\cdot + CCl_4 \rightarrow HCl + \cdot CCl_3$. (auth)

30238 (WERL-2989-1) APPLICATIONS OF THE MÖSSBAUER EFFECT IN SCIENCE AND TECHNOLOGY. Lawrence M. Epstein (Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.). Apr. 1965. Contract AT (30-1)-2989. 76p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Several applications of the Moessbauer effect, especially in chemistry, were explored. The following four areas received the most effort: a study of the isomer shifts of ferroin-type complex ions; a study of the isomer shifts and quadrupole splittings of some compounds of tin(IV) bonded to sulfur; a study of ferric ions in silicate glasses of varying composition; and demonstration of a device to modulate and detect a beam of gamma rays without moving parts. The objective of the glass studies was to determine from the spectra the variation of the ferric ion environment with changes in glass composition, but the purpose was largely defeated by two difficulties, namely, the tendency toward reduction of iron at low concentrations, and the long relaxation time of ferric ions at low concentrations, which resulted in Zeeman splitting. Additional iron compounds that were explored briefly, and which suggest interesting areas for additional work, include iron phthalocyanine, ferritin, hemoglobin, some sulfur-bridged iron complexes, and some iron(II) dithiolates. General techniques and applications of Moessbauer spectroscopy and interpretation of iron and tin spectra are discussed. (auth)

30239 PHYSICAL AND CHEMICAL PROCESSES ACCOMPANYING THE DISSOLUTION OF IRRADIATED SUBSTANCES, STUDIED BY MEANS OF LUMINESCENCE MEASUREMENTS. Gunnar Ahnstroem (Royal Univ. of Stockholm). Acta Chem. Scand., 19: 300-12(1965).

When certain gamma-irradiated substances were dissolved in water, a light emission was observed. Alkali halides seemed to be most efficient in this respect. In such systems the light emission was also considerably increased by the addition of certain fluorescent substances to the solvent. The light emission caused by dissolving irradiated NaCl in a fluorescein solution was studied as a function of the radiation dose in the range from 1 to 10^6 rad. In contrast to solid-state luminescence, for example thermoluminescence from irradiated alkali halides, the relative luminescence yield was found to increase with increasing total dose above around 30 rad. Substances such as O_2 and NO_3^- as well as reducing agents were found to quench the luminescence in concentration ranges where no effect could be observed on the light-induced fluorescein fluorescence. On the basis of these results, a hypothetical reaction mechanism was advanced in good agreement with experimental data. (auth)

30240 EFFECT OF IRRADIATION ON ANESTHETIC AGENTS. Lawrence B. Perry, James A. Meyer, John A. Jenicek, and Leo R. Goldbaum (Fitzsimmons General Hospital, Denver). Anesthesiology, 26: 106(Jan.-Feb. 1965).

Following a mass casualty situation subsequent to a nuclear attack or an accidental nuclear detonation, the question would arise as to whether salvaged and existing stocks of anesthetic agents would be chemically altered in any way by irradiation. A preliminary study was made to determine whether changes would occur by exposing a number of volatile anesthetic agents to irradiation and subsequently comparing these samples with known standards. Five volatile agents were examined: halothane, diethyl ether, divinyl ether, fluoroxene, and halothane-ether azeotrope. Samples of 2 ml of each agent were placed in glass-stoppered glass tubes and exposed to 150,000 R of γ radiation. The samples were then checked for change in volume, and compared with a standard by gas chromatography. A chromatograph which has a β-ionizing detector and a gas-liquid absorbing column was used. A description of the technique used in comparing the irradiated samples with the standards is provided. Gas chromatography showed no change in any agent tested. Both the irradiated and standard samples had identical retention times and similar peak heights. No break-down products were eluted. There were no volumetric changes in the samples irradiated. It is concluded that qualitative or quantitative changes in the agents could not be detected with the radiation doses and analytical techniques used. (BBB)

30241 ESR-SPECTROSCOPIC DETECTION OF A ^{33}S–SULFUR RADICAL. W. Rundel and K. Scheffler (Universitet, Tuebingen, Ger.). Angew. Chem. Intern. Ed. Engl., 4: 243-4(Mar. 1965).

Free radicals can be detected by electron spin resonance (ESR) spectroscopy in solutions of 2,4,6-tri-t-butylthiophenol (BTP) after irradiation with uv light; the radicals are stable for some time at room temperature ($t_{1/2}$ ca 30 min). The G factor of 2.0104 and the absence of any hyperfine structure in the ESR spectrum indicate that the unpaired electron is located largely on the sulfur atom. Participation of the sulfur in the free radical state should be recognizable from the hyperfine structure in the ESR-spectrum of the radical labeled with ^{33}S. Using a sample of BTP containing 11.5% ^{33}S, in addition to the main ESR signal (G = 2.0103 ± 0.0001) a symmetrically distributed weaker quartet due to the interaction of the unpaired electron with the nuclear magnetic ^{33}S isotope was also found. The intensity ratio of the signals was 100:12, corresponding to the ratio $^{33}S/^{32} + ^{34}S$ (value calculated from the isotope ratio, 100:13). The quartet had a splitting constant $a(^{33}S)$ of 14.75 G at a line width of 2.8 G. This proves that BTP is a genuine sulfur radical, most probably the tri-t-butylphenyl sulfide radical. To measure the ESR spectrum exactly, a solution in benzene of labeled BTP and dibenzoyl peroxide was heated to 80°C. Under these conditions, a relatively large stationary concentration of the radical is available for a long time. (BBB)

30242 ON THE RADIATION STABILITY OF VITREOUS RADIOACTIVE PREPARATIONS. F. S. Dukhovich and V. V. Kulichenko. At. Energ. (USSR), 18: 361-7(Apr. 1965). (In Russian)

Data are given on the influence of ionizing radiation on the chemical stability of vitreous materials used for radioactive waste fixation. It is shown that irradiation in air caused chemical changes on the surface of specimens, due to the heterogeneous radiochemical reaction of solids with air components. The products of reactions formed carbonates, hydroxides, and nitrates. (tr-auth)

30243 INDUCED γ RADIATION IN NEUTRON-IRRADIATED POLYETHYLENE. N. A. Dubinskaya, A. Yu. Lyul, and L. L. Pelekis. At. Energ. (USSR), 18: 418-19 (Apr. 1965). (In Russian)

The induced γ activity in high and low pressure polyethylene was studied using granulated polyethylene irradiated for 15 min and 4 hr by thermal neutrons at a dose of 9×10^{12} n/cm^2 sec in a vertical channel of the IRT reactor. The results of measurements carried out with scintillation γ spectrometer with 40 × 40 mm NaI(Tl) crystal are tabulated. (R.V.J.)

30244 YIELD OF OH RADICALS IN ALKALINE SOLUTIONS. RADIATION REDUCTION OF CHROMATE IONS IN SOLUTIONS SATURATED WITH HYDROGEN. J. Kalecinski (Inst. of Structural Research, Polish Academy of Sciences, Wroclaw). Bull. Acad. Polon. Sci., Ser. Sci. Chim., 13: 103-8(1965).

The yields of OH^- radicals from radiolysis of solutions in which the OH^- ion concentration exceeded 1 M were studied. An alkaline solution of potassium chromate was used. The alkaline solutions of chromate ion saturated with hydrogen and then γ-irradiated were reduced to chromite ion. The chromate concentration was not a linear function of the time of irradiation. It was possible to determine the yield of OH^- radicals from alkaline solutions from kinetic measurements of chromate ion reduction. (M.C.G.)

30245 EFFECT OF DENSITY IN THE RADIOLYSIS OF n-BUTANE. Totsuo Miyazaki and Shoji Shida (Tokyo Inst. of Tech.). Bull. Chem. Soc. Japan, 38: 716-20 (May 1965).

A study was made of the effect of density on the radiolysis of n-butane at 170°C over the density region of 0.006 to 0.575 g cc^{-1}. While $G(H_2)$ and $G(C_2H_6)$ were not affected by the density change, $G(CH_4)$ and $G(C_3H_8)$ decreased sharply in the density region from 0 to 0.1 g cc^{-1}. These facts may be interpreted in terms of the collisional deactivation of the excited ion. The rate constant of the fragmentation of the butane ion was estimated from the deactivation-fragmentation competition scheme and compared with the rate constant calculated from the quasi-equilibrium theory. Agreement was satisfactory. The formation of methane by ionic fragmentation near the critical state was also considered. (auth)

30246 THE RADIOLYSIS OF MONO-, DI- AND TRIMETHYLAMINE IN THE GAS PHASE. Setsuo Takamuku and Hiroshi Sakurai (Osaka Univ.). Bull. Chem. Soc. Japan, 38: 791-4(May 1965).

The γ radiolysis of methylamines in the gas phase was investigated by applying absolute dosimetry involving measurement of saturation ion currents in the gases during irradiation. The major volatile products were hydrogen, methane, and ammonia. Ion-pair yields of hydrogen for mono-, di- and trimethylamine were 3.10, 2.78, and 1.78, respectively. Those of methane were 0.10, 0.45, and 0.41 respectively. The yields of hydrogen and methane were independent of the pressure up to 300 mm Hg, but at pressures less than 100 mm Hg there were slight decreases in hydrogen yields. The rate of hydrogen formation from methylamine was proportional to the radiation intensity, and the yield decreased in the presence of a small amount of ethylene. By kinetic analysis of the results with an added scavenger, it was observed that 81% of the hydrogen formed from methylamine is caused by a radical process, while the value is 41% for trimethylamine. (auth)

30247 SEMICONDUCTING PROPERTIES OF TETRAMETHYLAMMONIUM POLYIODIDES AND THE IRRADIATION EFFECT. Shichio Kawai, Ryoiti Kiriyama, Madoka Uchida, Shigekazu Kusabayashi, and Hiroshi Mikawa (Osaka Univ.). Bull. Chem. Soc. Japan, 38: 799-805(May 1965).

Measurements of the temperature-dependence of d-c conductivity were made with tetramethylammonium polyiodide in different crystallographic directions, perpendicular to and parallel to the nets of iodine atoms. The systematic increase in the number of iodine atoms from tetramethylammonium triiodide to tetramethylammonium enneaiodide is accompanied by a gradual increase in conductivity. The activation energy for the conductivity along the iodine net is determined mainly by the shortest distance between polyiodide ions. As in the case of crystalline iodine, hole conduction is predominant in polyiodide crystals. From the standpoint of structural considerations and the values of the activation energies, the fundamental process in hole con-

duction seems to be essentially the same in both polyiodides and solid elementary iodine. The radiation effects on the electric conduction may be classified as two distinct types: the effects of radiation, which can easily be removed by annealing above about 30°C, and the effects, which can not be overcome by heat treatment below 70°C. The conductivity increased on x-irradiation, indicating the production of some acceptor levels, while the conductivity decreased with γ-irradiation, a phenomenon which may be attributed to some sort of donor level formation. (auth)

30248 PULSE RADIOLYSIS APPLIED TO POLYMERIZATION REACTIONS: THE INTERMEDIATE IN THE RADIATION-INDUCED POLYMERIZATION OF ALPHA-METHYLSTYRENE. Meiseki Katayama, Motoyoshi Hatada, Kozo Hirota, Hatsuo Yamazaki, and Yasutomo Ozawa (Hokkaido Univ., Sapporo; Japanese Assn. for Radiation Research on Polymers, Osaka; and Osaka Univ.). Bull. Chem. Soc. Japan, 38: 851-2(May 1965).

An investigation was made to confirm the anion radical mechanism in radioinduced polymerization and to obtain quantitative rate data by direct observation of the reaction intermediate. The α-methylstyrene monomer was irradiated in an electron beam. (M.C.G.)

30249 RADIATION CHEMISTRY OF METHYLENE BLUE. Nganshou Wai, Tsu-chang Hung, and Lai-su Lee. Bull. Inst. Chem., Acad. Sinica, No. 10, 14-24(Jan. 1965).

Methylene blue solution was irradiated by ^{60}Co gamma rays and 65 kvp x rays. The initial yield (G_0) for leucobase in aqueous solution was variable with the concentration of methylene blue and the total doses absorbed. The G (MbH_2) was found to be less than the half of G(H) = 2.9 molecules per 100 ev. With addition of 0.4 M ethanol or 0.2 M sodium benzoate, the G(MbH_2) showed higher values than for pure methylene blue, especially for small doses of x radiation. During irradiation of methylene blue dissolved in absolute alcohol for the purpose of decreasing the hydrogen and hydroxyl radicals, the $G_0(MbH_2)$ was as low as 0.06 molecules per 100 ev. These experimental results showed a good agreement with the suggestion of the mechanism for the reduction of methylene blue by hydrogen radicals and for the oxidation by hydroxyl radicals. (auth)

30250 EFFECT OF X-RAYS ON THE STABILITY OF EDTA CHELATES OF Co(II), Ni(II), Cu(II) AND Zn(II). Jy-shih Wang. Bull. Inst. Chem., Acad. Sinica, No. 10, 56-62 (Jan. 1965).

The EDTA chelates of Co(II), Ni(II), Cu(II), and Zn(II) were prepared and recrystallized. The equivalent conductances of the aqueous solutions of these chelates were measured and found to increase after x ray irradiation. (auth)

30251 RADIATION CHEMISTRY OF AQUEOUS CHLORAL HYDRATE SOLUTIONS. APPLICATION TO CONTINUOUS DOSIMETRY AND ROENTGENMETRIC TITRATION. Ken'ichi Sugimoto and Soichiro Musha. Bull. Univ. Osaka Prefect., Ser. A, 11: 67-72(1962).

The chemical effects of γ rays on aerated aqueous solutions of chloral hydrate were studied. The chemical reaction was the conversion of chloral hydrate to hydrochloric acid. The chemical change was proportional to radiation dose and the yield of hydrochloric acid was independent of dose rate. Nevertheless, the yield depended on initial concentration of chloral hydrate. This reaction was used for continuous chemical dosimetry and roentgenmetric titration. (auth)

30252 THE APPLICATION OF SEVERAL METHODS OF NUCLEAR PHYSICS AND RADIOCHEMISTRY FOR INVESTIGATIONS AND MEASUREMENTS IN THE CEMENT AND LIME INDUSTRY. Kwiecinski, S.; Matula, J. Cement-Wapno-Gips, 18/28: No. 7-8, 167-74(1963). (In Polish)

Possibilities of solving technical problems in the cement industry by means of radiochemical methods such as radiometric measurements, absorption, fluorescent, neutron, and other methods are given. (OID)

30253 RADIOCHEMISTRY IN TECHNOLOGY. S. Roesinger (Farbwerke Hoechst AG, Frankfurt am Main). Chem.-Ingr.-Tech., 37: 128-37(Feb. 1965). (In German)

Energetic radiation has been used in the synthesis of ethyl bromide and in the irradiation of plastics for the preparation of contact foils, cable insulators, and semiconductors in chemical technology. Since the irradiation costs could be decreased and technological experience with radiochemical reactions is available, it appears to be possible that laboratory-scale tested reactions could be used for mass production, as, e.g., the synthesis of sulfonic acid, polymerization of ethylene, or preparation of a hard ligneous plastic. A survey is given of the present state of the technology in these areas. (tr-auth)

30254 LOCALIZATION OF ENERGY IN RADIOLYSIS OF SOLUTIONS. I. FORMATION OF HYDROGEN AND HYDROGEN CHLORIDE IN MIXTURES OF CYCLOHEXANE WITH CARBON TETRACHLORIDE. J. Urban and J. Bednar (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Collection Czech. Chem. Commun., 30: 976-82(Apr. 1965).

Study of the radiolysis of mixtures of cyclohexane with carbon tetrachloride in the whole concentration range showed that the mixture consecutively behaves as a dilute and concentrated carbon tetrachloride solution, then as an individual mixture, as a concentrated cyclohexane solution, and finally as a dilute solution of cyclohexane in carbon tetrachloride. Each of the five concentration ranges given is characterized by its reaction mechanism and partition of the absorbed energy to both components. (auth)

30255 LOCALIZATION OF ENERGY IN RADIOLYSIS OF SOLUTIONS. II. YIELDS OF OH AND OD RADICALS IN MIXTURES OF LIGHT AND HEAVY WATER. B. Bartonicek, J. Janovsky, and J. Bednar (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Collection Czech. Chem. Commun., 30: 1328-31(Apr. 1965).

The yields of OH^- and OD^- radicals from radiolysis of neutral mixtures of light and heavy water were determined. The value of G_{OD^-} for pure heavy water was also found. The samples were irradiated using gamma radiation from ^{60}Co sources. The value $G_{OH^-} = 2.40 \pm 0.10$ found was in agreement with usually reported value ± of the yield of OH^- radicals from neutral light water. The values for $G_{OH^-+OD^-}$ ranged from 2.12 to 2.57. The value obtained for G_{OD} in pure heavy water was 2.61 ± 0.10. (M.C.G.)

30256 IMPROVEMENT OF THE QUALITY OF INSULATING MATERIALS BY IRRADIATION. Rexer, E. Elektrie, 18: 145-9(May 1964). (In German)

The physical and chemical foundations of radiation effects on high polymers are discussed. Starting with the primary effect of high-energy radiation on carbon compounds, the energies involved in the mechanism of interlacing through free radical formation, the radiation vulcanization of rubber, and graft polymerization induced by nuclear radiation are discussed. Various radiation sources and the economic and technical problems involved in the practical application of irradiation are also discussed. ^{60}Co γ rays and β rays from electron accelerators can be applied as radiation sources, but from the viewpoint of a better utilization of the emitted energy the electron radiation with its high ionization density seems to be superior to γ-radiation. As far as insulating material is concerned, one-sided, 2-sided, and circular irradiation can be distinguished with the latter being the most effective method of increasing insulating capacity. The planning, operation, and control of a cable irradiating plant are described in which Van de Graaff linear accelerators and cascade generators are used to improve the insulating characteristics and physical strength of insulators. (OID)

30257 EFFECT OF NUCLEAR IRRADIATION AT AMBIENT TEMPERATURES ON THE VISCOSITY AND CHEMICAL STRUCTURE OF A COAL TAR PITCH. A. Roeger. Fuel, 43: 357-66(Sept. 1964).

In experiments to obtain information on the use of pitch as a radiation-resistant material, a high-temperature coal tar pitch was subjected to reactor irradiation (gamma plus neutron). The commercial pitch studied had a coking value 44.2%, a density of 1.29 at 25°C, a sublimation point of 96.0°C, and was 7.8% insoluble in quinoline and 25.2% insoluble in benzene. The ground samples were wrapped in

cadmium sheet and positioned at the center of one face of the Pennsylvania State University Reactor. The various total dosages ranged from 3.5×10^4 to 3.5×10^8 rad. After exposure, the samples were tested by viscosity measurements, infrared analysis, x-ray diffraction analysis, and mass spectrometric analysis of the evolved gas. All these methods of test indicated that the pitch underwent negligible changes in its physical and chemical structure. The high stability of pitch towards pile irradiation is attributed to its highly aromatic nature. (UKAEA)

30258 PREPARATION OF Rb^{86}. Yang, Mo-hsiung; Chang, Chau-ting. Hua Hsueh, No. 1, 38-40(Mar. 1964). (In Chinese)

Instead of using Rb_2CO_3 as the target material, 10 mg of RbCl was irradiated for 30 to 120 hr at a thermal neutron flux of 10^{12} n/cm^2/sec. After cooling, the irradiated target was treated by the ion-exchange method to remove the radiation-induced ^{35}S and ^{32}P. The γ-ray spectrum of the ^{86}Rb (1.08 Mev) obtained was in good agreement with other reports. (OID)

30259 THE CHEMISTRY OF GAMMA-IRRADIATED WOOD. Seifert, K. Holz. Roh- Werkstoff, 22: 267-75 (July 1964). (In German)

Under the impact of γ radiation, wood undergoes changes in sorption and hygroscopicity, and the digestibility and food value for certain organisms increase. Although high-intensity radiation causes a reduction in its mechanical strength, low-dose irradiation produces an increase in mechanical strength. A thorough analysis of the chemical structure and chemical properties of wood irradiated with low γ doses was made in order to deduce from the structural modification the causes for increased strength of low-dose irradiated wood. Tests were made with 10mm thick boards (25 × 5 cm) of pine, birch, and spruce irradiated with a ^{60}Co source from 10 to 10^8 r at 40°C. Before and after irradiation, the wood samples were analyzed for cellulose, lignin, pentosan, carboxyl, and methoxyl groups, alkali solubility, sugars, alcohol extracts, chain length, and fine structure by x ray analysis. No new discoveries were made in the high irradiation range (10^4 to 10^8 r), but in the range from 10 to 10^3 r high polymers of wood disintegrated, but this loss was more than compensated for by the partial crosslinking of the wood constituents. Conclusions based on chromatographic and rontgenographic observations indicated that γ rays first decomposed some parts of the wood micelles, which were still in their lattice-like order, and acquired through intermolecular connection an even higher degree of order which might be the cause of the increased strength. (OID)

30260 CHEMICAL ACTIVATION BY THE Br^{82m} ISOMERIC TRANSITION. THE HALF-LIFE OF Br^{82m}. R. M. Iyer and J. E. Willard (Univ. of Wisconsin, Madison). J. Am. Chem. Soc., 87: 2494-5(June 5, 1965). (COO-32-107)

Neutron-irradiated Br_2 was dissolved in CCl_4 at short times after irradiation, allowed to stand, and examined for ^{82}Br activity in organic combination following extraction of Br_2. The decrease in the amount of this activity as a function of time after irradiation at which the bromine was mixed with the CCl_4 was used to determine the half life of ^{82m}Br. The data were used to estimate the fraction of the decay events, which led to organically bound ^{82}Br. There was substantial ^{82}Br activity in the CCl_4 after extraction of the Br_2. It was found that 39% of the ^{82}Br atoms are fixed in organic combination. The value obtained for the half life of ^{82m}Br was 6.2 ± 0.1 min. (M.C.G.)

30261 IRRADIATION STABILITY OF SULFONATED STYRENE RESINS CROSSLINKED WITH VARIOUS DIVINYLBENZENE SIOMERS AND MIXTURES THEREOF. Richard H. Wiley and Giovanni Devenuto (Univ. of Louisville, Ky.). J. Appl. Polymer Sci., 9: 2001-7(June 1965). (TID-20954)

The ^{60}Co γ-induced degradation of sulfonated styrene resins crosslinked with 4 and 8 mole % m- or p-divinylbenzene isomers, or mixtures thereof including commercial divinylbenzene showed a loss in capacity of 5 to 12.8% at radiation intensities of about 290,000 r/hr and total doses of 0.91 to 0.90×10^8 rad in the presence of water. The loss was less for the 8% crosslinked resins and was less (2 to 6%) if irradiated dry. The resins crosslinked with commercial divinylbenzene showed slightly higher loss of capacity (11.2 to 11.9%) than did the others (10.2 to 10.7%), presumably due to the ethylphenyl contamination. The moisture content also increased on irradiation; 13 to 16% for the 8% and 2.7 to 3.0% for the 4% resins at 1.90×10^8 rad. The meta crosslinked resin showed somewhat lower moisture content increase (1.5% for 8%; 0.8% for 4%), indicative of a more stable cross-linkage. The results are discussed in terms of the reactions involved: desulfonation, hydroxylation, and cleavage of crosslinkages. (auth)

30262 MASS-SPECTROMETRIC STUDY OF IONS AT NEAR-ATMOSPHERIC PRESSURE. II. AMMONIUM IONS PRODUCED BY THE ALPHA RADIOLYSIS OF AMMONIA AND THEIR SOLVATION IN THE GAS PHASE BY AMMONIA AND WATER MOLECULES. A. M. Hogg and P. Kebarle (Univ. of Alberta, Edmonton). J. Chem. Phys., 43: 449-56(July 15, 1965).

A new mass-spectrometric method for the study of solvation of ions and of ion complexes was applied to the ammonium ion. The major ion in the α-particle radiolysis of NH_3 is the clustered ammonium ion $NH_4^+ \cdot nNH_3$. A study of the distribution of these clusters was made at room temperature and in the pressure range 0.05 to 200 Torr ammonia. Clusters up to n = 20 can be observed. The intensity distribution of the ions showed that the inner solvation shell contains four molecules. Approximate free-energy changes for inner- and outer-shell solvation were obtained. Studies of competitive solvation of the NH_4^+ ion by water and ammonia molecules confirmed the inner four shell. Ammonia is preferentially taken up in the inner shell and water in the outer shell. The higher stability of the ammoniated inner shell requires a very small effective NH_4^+ radius. This requirement leads to an examination of the structure of the $NH_4^+ \cdot 4NH_3$ ion. (auth)

30263 ELECTRON SPIN RESONANCE AND OPTICAL ABSORPTION IN GeO_2. R. A. Weeks and T. Purcell (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 43: 483-91 (July 15, 1965). (ORNL-P-524)

Paramagnetic states of GeO_2 in the glass and in the powdered crystalline hexagonal and tetragonal phases were investigated by the means of electron spin resonance after irradiation with γ rays and electrons. Three of the resonances observed in the glass were identified as intrinsic paramagnetic states on the basis of concentration, g values, and the shapes of the resonances. The g values of these lines were 1.9957, 2.0060, and 2.0080. The g = 1.9957 line had a shape which was invariant with temperature (300, 78, and 2°K) and with magnetic field. The shape was a characteristic powder pattern for a center with $S = \frac{1}{2}$ and an approximately axially symmetric g tensor, where $g_{||} = 2.0016$ and $g_{\perp} = 1.9957$. This line was characteristic of all glass and hexagonal crystal-phase specimens for all irradiations at temperatures ~300°K. The spin concentration after an irradiation of ~10^{17} (1.5 Mev) electrons cm^{-2} was ~3×10^{18} cm^{-3} with no indication of saturation. Tentative correlation of this paramagnetic center with optical absorption in the region of 4.5 ev was established by a series of irradiations and subsequent heat treatments. The data on the g = 1.9957 line was sufficient for the proposal of a model in which an electron is trapped at an oxygen vacancy. The g = 2.0080 line was observed in all electron-irradiated glass specimens and the g = 2.0060 line was found in all γ irradiated glass specimens along with the g = 2.0080 line. Other lines were observed at lower g values in β and γ irradiated glass and were tentatively assumed to be due to impurities. Irradiation of the glass with ^{60}Co γ rays at 78°K and measurements without intervening warmup show showed only one resonance with g = 1.9957 but with a shape quite different from the g = 1.9957 line found after irradiation with the same dose of ^{60}Co γ rays at approximately 40°C. This line was assumed to be another intrinsic center. Resonances observed in the tetragonal-phase powder bore no relation to the resonances in the glass and hexagonal-phase powder. (auth)

30264 DETERMINATION OF THE FLUORESCENCE SPECTRA OF RARE GASES EXCITED BY ALPHA PARTICLES. R. Henck and A. Coche (Centre de Recherches Nucleaires, Strasbourg). J. Phys. (Paris), 26: 110-16 (Mar. 1965). (In French)

With a spectrophotometer using the single photoelectron technique, the fluorescence spectra of noble gases excited by the α-particles of ^{210}Po were determined; the gas pressure being varied in the range between 6 atmospheres and a few hundred millimetres of mercury. In the cases of helium and neon, a characteristic emission of the nitrogen molecule or ion was mainly observed. This is due to an important energy transfer to the nitrogen although the content of this gas is negligible. This effect was smaller in the case of argon, where, in addition, the origin of the emission spectrum is not well known. Finally, in the cases of krypton and xenon, a continuous spectral distribution was observed arising from the de-excitation of diatomic molecules occurring during three-body collisions. (auth)

30265 THERMOLUMINESCENCE OF LiF AT LOW TEMPERATURE. J. Tournon and P. Berge (CEN, Saclay, France). J. Phys. (Paris), 26: 147-9(Mar. 1965). (In French)

Lithium fluoride crystals, γ irradiated at room temperature, were excited in the F-center band at 78°K. When heated the crystals emit peaks of thermoluminescent light at 100 and 150°K. The quantities of emitted light depend on the time of γ irradiation, duration of excitation, and number of thermoluminescence experiments performed, starting from a fresh crystal. A model is proposed to explain the experimental results. (auth)

30266 ANNEALING OF RADIATION DAMAGE IN SOLIDS. S. R. Mohanty (Banaras Hindu Univ., India). J. Sci. Ind. Res. (India), 24: 63-72(Feb. 1965).

There are four basic solid types, viz. molecular, ionic, metallic, and valence crystals, which behave in different ways under irradiation. In organic or molecular crystals, the individual molecules are relatively isolated from one another so that the atoms in the molecules relax rapidly when the electronic state is changed. Free radicals are introduced and bonds rearranged principally as a consequence of electronic excitation. The damage in atomic-particle irradiation was shown as the collision of an incident particle with a lattice atom to produce a displacement. The primary displaced atom collides with another atom to produce a secondary displaced atom, and both the primary and the secondary displaced atoms cause further displacement. As distinguished from damage produced by atomic projectiles, energetic electrons and γ rays produce random distribution of interstitial-vacancy pairs in which the distance between the interstitial and the vacancy rarely exceeds 4 to 5 interatomic distances. This simplest form of damage arises from the primary knock-ons, which usually have sufficient energy to cause further displacements. Theories of the kinetics of radiation damage annealing are discussed. It is shown that annealing in even the simplest form of radiation damage is very complex. (F.J.H.)

30267 ISOTOPE PREPARATION BY SECONDARY NUCLEAR REACTIONS. Nagy, Agnes G.; Kiss, Istvan; Molnar, Ferenc (Magyar Tudomanyos Akademia, Kozponti Fizikai Kutato Intezet, Budapest). Magy. Tud. Akad. Kem. Tud. Oszt. Kozlemen., 23: 89-107(1965). (In Hungarian)

Radioisotopes may be produced in atomic reactors by primary (n,x) methods as widely used today, and by secondary methods (p,x), (d,x), (t,x), (α,x). Secondary methods produce isotopes by fast neutrons colliding with the components of the reactor (water, heavy-water moderator) creating high-energy protons or deuterons; the thus created isotopes, and their importance are discussed. The following method was used successfully to produce carrier-free iron and copper isotopes: $^{64}Zn(n,p)^{64}Cu$, and $^{59}Co(n,p)^{59}Fe$. The isotope production in Hungary consists of 90% (n,γ) and 7% (n,p) reactions and 3% by fission or other processes. Mathematical treatment of the energetic aspects are presented to account for the processes in secondary reactions in the production of various isotopes. A list of all the isotopes thus far produced by secondary reactions is given and the results obtained to date provided in detail on: ^{7}Be, ^{11}C, ^{12}N, ^{13}N, ^{14}N, ^{15}N, ^{16}N, ^{17}N, ^{17}F, ^{18}F, ^{20}F, ^{21}F, ^{28}Mg, ^{28}Al, ^{19}O, ^{34}Cl, and ^{138}Ba. (TCO)

30268 EFFECT OF LIGANDS ON THE RATE OF REDUCTION OF COBALT(III) COMPLEXES BY RADIOLYTICALLY PRODUCED HYDROGEN ATOMS. M. Anbar and D. Meyerstein (Weizmann Inst. of Science and Soreq Nuclear Research Center, Rehovoth, Israel). Nature, 206: 818-19(May 22, 1965).

The rate of reaction of radiolytically produced hydrogen atoms with $Co(III)(NH_3)_5$ X complexes was determined. The measurements were carried out using competition kinetics following the hydrogen abstraction from 2-D-isopropanol or D_3-methanol. The ratio $R = HD/H_2$ in the hydrogen evolved was measured, and the rates of reaction of the complexes were evaluated. A comparison of the results with the rates of reaction of complexes with aquated electrons demonstrated a significant difference in the effects of ligands on the reactivity. The rates of reduction of cobalt complexes by hydrogen atoms were several orders of magnitude slower than the corresponding reactions with hydrated electrons. (P.C.H.)

30269 ORIGIN OF RADIO-RESISTANCE OF PAIRED SUBSTITUTED BASES: 9-ETHYL-GUANINE AND 1-METHYL-CYTOSINE. A. Checcucci, J. Depireux, and J. Duchesne (Université, Liège). Nature, 206: 925-6 (May 29, 1965).

Because of the presence of paired complementary bases in DNA, studies were made on the part played by hydrogen bond interactions in the determinations of the radio-resistance of such complexes. The electron spin resonance method was used for 9-ethylguanine and 1-methylcytosine as well as for their three-hydrogen-bonded pairs, all the compounds being irradiated in vacuo at room temperature. From the results it was concluded that the substantial increase in radioresistance on going from nucleotides (G_R = 3) to DNA'S (G_R = 0.5) must be due not only to a mass effect, but also to the hydrogen bond interactions governing the double-stranded structure. (P.C.H.)

30270 RADIATION-THERMAL CRACKING OF PROPANE. Vikt. I. Spitsyn, G. G. Ryabchikova, L. S. Polak, P. Ya. Glazunov, and A. A. Yakubovich. Neftekhimiya, 3: 615-19(July-Aug. 1963). (In Russian)

The radiation-thermal cracking of propane was investigated in comparison with thermal cracking under the same conditions. The activation energy for the process of radiation-thermal cracking is close to the activation energy for the continuation of the chain in thermal cracking. The use of ionizing radiation for initiation of the chain reaction makes it possible to carry out the cracking of propane with a significant degree of conversion at temperatures lower than the usual temperature of thermal cracking at ~100°. The radiochemical yields under the conditions used were $\sim 10^3$ molecules at 100 ev. (tr-auth)

30271 INFLUENCE OF IONIZING RADIATION ON THE KINETICS OF HYDROGEN PEROXIDE ACCUMULATION IN THE OXIDATION OF CUMENE UNDER HIGHER TEMPERATURES. ROLE OF IMPURITIES CONTAINED IN THE CUMENE. V. L. Antonovskii, I. A. Kuznetsov, et al. Neftekhimiya, 1: 863-8(1964). (In Russian)

The kinetics of the accumulation of hydrogen peroxide in cumene at 60 to 120°C under x irradiation was investigated. At 90°C and higher the irradiation accelerates the reaction in the initial period, shortening the induction period. For measurement of the accumulation of hydrogen peroxide the effect of the radiation becomes imperceptible. The yield of the radicals during the irradiation of cumene is 1.5 at 100 ev. Impurities present in commercial cumene essentially changed the character of the effects of radiation on the oxidation kinetics of cumene. Hydrogen peroxide during radiation-thermal oxidation is accumulated with uniform speed depending on the quantity of impurities in the cumene and not depending on the power of the radiation dose. For effective intensification of the oxidation processes of cumene into hydrogen peroxide during increasing tem-

peratures with ionizing radiation, it is necessary to use sufficiently pure cumene and exposure to limit the induction period. (tr-auth)

30272 RADIOLYSIS OF CYCLOHEXANE. EFFECT OF THE TEMPERATURE AND THE AGGREGATE STATE OF CYCLOHEXANE. V. I. Makarov. Neftekhimiya, 4: 314-19(Apr. 1964). (In Russian)

The significant effect of the aggregate state on the yields of the radiolysis products of cyclohexane, formed as a result of the rupture of C–C bonds, was established. The yields of the products of the C–H bond ruptures (cyclohexene and dicyclohexyl) do not change by modification of the aggregate state solid–liquid. The yields of cyclohexene and dicyclohexyl do not depend on the temperature in the interval from −196 to +50°, but the hydrogen yield is slightly dependent on temperature. The radiochemical yields of the fragment products C_1 to C_4 at doses of 3×10^{19} ev/ml were determined. The experimental results found for the yields of the fragment products are explained on the basis of the introduction of three possible types of monomolecular decompositions of the excited molecules of cyclohexane and the possibility of cage effects on the yield of these products. (tr-auth)

30273 QUANTITATIVE STUDIES OF RADIATION POLYMERIZATION. Joon Taik Han. New Phys. (Korea), 3: No. 2, 35-40(1963). (In Korean)

One of the possible effects of radiation, called gel phase formation in which a polymerizable substance undergoes a sudden change to a gel-like solid, was believed to be the consequence of extensive crosslinking which resulted in the formation of an infinite network. The gel formation was associated with a very small radiation dose increment, usually approximately 2% of the total gelation dose. The effects of storage time and temperature were investigated. A sensitivity increase of approximately 6% occurred within a period of 4 days after which the sensitivity remains constant. The required dose was approximately the same at −25°C as that required at room temperature. There was evidence that the effects of radiation on materials will be same for both x and γ rays within experimental errors. The dose rate was independent of polymerization. Complete polymerization was produced by thermal neutron. (auth)

30274 LUMINESCENCE AND THERMAL STIMULATION OF NaCl AND CaF_2 UNDER X-RAY EXCITATION AT A LOW PRESSURE. G. M. Ivanii. Opt. Spectry. (USSR) (English Transl.), 18: 177-8(Feb. 1965). Translated from Opt. i Spektroskopiya, 18: 322-4(Feb. 1965).

A study was made of the luminescence intensity during x-irradiation and subsequent thermal stimulation of natural single crystals of NaCl and CaF_2 at reduced and atmospheric pressure. Data are presented in graphs. The luminescence intensity and the shape of the thermostimulation curves on changing from atmospheric to a reduced pressure are somewhat altered. The luminescence intensities are greater at reduced pressures and the peak temperatures of the thermoluminescence curves are shifted in the direction of lower temperatures. A quenching action of water vapor was observed. (M.C.G.)

30275 MECHANISM OF X-RAY EMISSION IN KBr: Cu SINGLE CRYSTALS. R. Oggioni and P. Scaramelli (Universita, Milan). Phys. Status Solidi, 9: 423-34(1965).

A study is made of the mechanism for Cu-luminescence in KBr : Cu single crystals excited by ionizing radiation. The following results are obtained: In the spectral range 200 to 1200 nm the same emission band (centered about 392 nm at 77°K) occurs as is obtained by means of uv excitation at 265, 235, and 210 nm. Under optical stimulation in the F band the same emission band at 392 nm is again observed. The build-up of the 392 nm band under x-ray and F light stimulation in the temperature-range 77 to 700°K is also studied, and the results are found to be complex. KBr : Cu samples which are x-irradiated at 77°K, or F-stimulated at 77°K after x ray irradiation at 290°K, show four glow peaks of thermoluminescence due to Cu impurities in addition to the glow peaks of pure KBr crystals. Emission spectra under all glow peaks are also observed; in these spectra the emission band due to Cu is always present. Measurements of the thermal bleaching of crystals which have been x irradiated at 77°K are correlated with the intensity-changes of the photoluminescence band of the Cu emitter. The assumption that emission under x irradiation can be explained as an alternate trapping of free holes and electrons by the emitter center Cu^+, is consistent with most of the results. Thermoluminescence and thermal bleaching experiments are also discussed. It is suggested that some of the glow peaks due to Cu impurities may be explained in terms of electron traps bound to Cu^+ ions substituted in the lattice. The presence of these traps seems to explain the observed build-up of the 392 nm emission band under x irradiation, and the observed effects after an ageing at different temperatures. (auth)

30276 THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS OF NUCLEIC ACIDS AND NUCLEOPROTEINS. Scholes, G. (Univ. of Durham, Eng.). Progr. Biophys. Mol. Biol., 13: 59-104(1963).

A review (with 87 references) is presented on the chemical and physicochemical effects in aqueous solution where the action of ionizing radiation is indirect, being mediated by the active species produced by the action of the radiation on water. Emphasis is placed on the radiation chemistry of pyrimidines, purines, and their nucleosides and nucleotides in solution since this has led to much information on the nature of the primary events that occur in the polynucleotides. Certain aspects of the nature of the action of radiations on aqueous systems are discussed that are essential for the understanding of the problems under consideration. It has been shown that purines in aqueous systems are more resistant to radioinduced degradation than the pyrimidines. There are indications that the protein protects the DNA from radiation-induced damage, and this is one of the most important recent developments in the field of radiation effects on DNP in aqueous media. Recent data, both chemical and physicochemical, indicate that in the initial stages of the radiolysis the radicals react preferentially with the protein of DNP. That the radicals are, in fact, reacting with the protein at low doses has been recently proved using a radioinduced ^{14}C-carboxylation technique. (TCO)

30277 THERMAL ANNEALING OF COPPER PHTHALOCYANINE IRRADIATED WITH NEUTRONS, HAVING UNDERGONE PRELIMINARY TREATMENTS. Melle M. Pertessis (Centre d'Etudes Nucleaires, Athens). Radiochim. Acta, 4: 44-7(May 1965). (In French)

Thermal annealing of neutron-irradiated copper phthalocyanine, which was previously treated by γ rays, electrons, or heat, was studied. The annealing curves between 140 and 190°C showed a retention minimum corresponding to a heating period between 15 and 90 min. In the case of γ-preirradiated phthalocyanine, the minimum faded with rising temperature: above 195°C the classical annealing curve was obtained (auth)

30278 INVESTIGATION OF THE EFFECT OF X-IRRADIATION ON THE CONDUCTIVITY OF HALOGEN DERIVATIVES OF METHANE AND BENZENE AND ON THEIR SOLUTIONS IN DIETHYL ETHER. A. N. Trofimova. Sb. Nauchn. Tr. Dnepropetr. Inzh.-Stroit. Inst., No. 29, 41-5 (1963). (In Russian)

The halogen derivatives of methane and their solutions in diethyl ether do not modify the conductivity under the effects of x radiation with $\lambda = 1.5$ Å. The conductivity of halogen derivatives of benzene and their solution in diethyl ether during irradiation with x rays increases (for bromobenzene, for example, 2.77 times). The decrease of the conductivity of the liquids indicated up to stationary vague values proceeds by hyperbolic law of type 2 with the exponent $n = 1.2$ to 2. An increase of the conductivity with time after exposure can be represented with expressions of type I with broad intervals of the spectrum of time relaxation. The presence of a preliminary drop of the conductivity during irradiation and of some increase after irradiation indicates the presence of some competing processes affecting the conductivity. The complex character of the

kinetics of the liquids suggests that the change of the conductivity in the liquids exhibits superimposed processes of elimination, capture, and recondensation of electrons and holes in the x radiation field. Changes in the conductivity during irradiation have a reverse character and good reproducibility. The exposure of the platinum electrodes to x radiation did not cause noticeable changes in the conductivity of the systems studied. (tr-auth)

30279 SPONTANEOUS EMISSION AND STIMULATION OF TELLURIUM BY ELECTRON BOMBARDMENT. C. Benoit a la Guillaume and J. M. Debever (Ecole Normale Superieure, Orsay, France). Solid State Commun., 3: 19-20(Jan. 1965). (In French)

The recombination emission of tellurium excited by a beam of 15-kev electrons was observed. The emission is polarized perpendicularly to the axis and should correspond to a vertical transition. The stimulated emission for an electron current higher than 200 μamp at 4°K was observed. (tr-auth)

30280 ENERGY TRANSFER EFFECTS IN THE RADIATION CHEMISTRY OF DIMETHYL ANILINE, PHENETOLE, AND CUMENE. F. S. Dainton, I. Kosa-Somogyi, and G. A. Salmon (Univ. of Leeds, Eng.). Trans. Faraday Soc., 61: 871-6(May 1965).

$G(-FeCl_3)$ values for solutions of $FeCl_3$ in liquid and crystalline dimethylaniline (DMA), liquid and crystalline phenetole and liquid cumene were measured. For liquid DMA, $G(-FeCl_3) = 2.0 \pm 0.2$, independent of $[FeCl_3]$ up to 1.4 mM, above which it increased. For crystalline DMA at −78 and −196°C, $G(-FeCl_3)_0$ increased markedly with concentration, attaining values ~25 at 5 mM. Previous data on phenetole were extended to higher concentration (4 mM) and followed a similar pattern. Liquid cumene systems were similar to liquid DMA systems. It was considered that exciton transfer was responsible for the high initial G values in the crystalline solutions. (auth)

30281 RADIOLYSIS OF AERATED SOLUTIONS OF POTASSIUM BROMIDE. A. Rafi and H. C. Sutton (Edinburgh Univ.). Trans. Faraday Soc., 61: 877-90(May 1965).

The γ-induced radiolysis of aerated solutions of potassium bromide in the concentration range 10^{-4} to 1M was studied at pH 2. Bromine was produced under all conditions; at low bromide concentrations it was only an intermediary product owing to its decomposition by a radiation-induced reaction with H_2O_2 to form HBr and O_2, but in 1M solutions it was a stable endproduct. A mechanism was proposed to account for the product yields $G(H_2O_2)$, $G(-O_2)$, $G(\Sigma Br_2)$, and $G(H_2)$ observed over a wide range of conditions, and for the kinetics of the above decomposition reaction as observed in mixtures of KBr, Br_2, and H_2O_2. The magnitudes of various kinetic parameters were obtained. The yield of "molecular" H_2O_2, $G_{H_2O_2}$, was determined from measurements of $G(H_2O_2)$ and of $G(-O_2)$, and was found to decrease from 0.75 molecules/100 ev at zero bromide concentration (extrapolated value) to 0.10 ± 0.03 in 1M KBr. This variation was similar to that reported in other systems for G_{H_2} as influenced by the concentration of KNO_3 and of H_2O_2. (auth)

30282 CHEMICAL EFFECTS OF THERMAL NEUTRON CAPTURE. MIXED CRYSTALS OF PHOSPHATES AND ARSENATES. R. F. C. Claridge (Kernforschungsanlage, Julich, Ger.). Trans. Faraday Soc., 61: 897-908(May 1965).

A study of the fate of ^{32}P and ^{76}As produced by the $^{31}P(n,\gamma)^{32}P$ and $^{75}As(n,\gamma)^{76}As$ reactions by neutron irradiation of mixed crystals of potassium dihydrogen phosphate and potassium dihydrogen arsenate was carried out by using chemical separations and paper electrophoresis. Some crystals of potassium dihydrogen phosphate containing lithium dihydrogen phosphate were also examined. The introduction of arsenate into the phosphate lattice was found to cause a reduction in the orthophosphate retention at low arsenate content. For crystals of higher arsenate content an oxidative process was postulated, which led to an increase in the orthophosphate retention. Thermal annealing, ultraviolet annealing, and some pressure annealing studies were made on the series of mixed crystals. Some possible mechanisms for the observed effects are discussed. (auth)

30283 ELECTRON SPIN RESONANCE OF IRRADIATED DNA. Shulman, R. G.; Pershan, P. S. (Bell Telephone Labs., Murray Hill, N. J.). Trans. N. Y. Acad. Sci., 27: 210-14(Dec. 1964).

By studying electron spin resonance, it was possible to observe the free radicals formed when DNA was irradiated. Of the four bases in DNA only one, thymine, contains a methyl group. After irradiating DNA, the free radical most conspicuously observed could be identified by the interaction between the unpaired electrons and a CH_3 methyl group. The derivative of the absorption intensity is plotted vs the external magnetic field which creates the Zeeman splitting. In the thymine radical, postulated to be responsible for the damage, a H atom has been added to the C_6 position, partially saturating the ring double bond of the thymine. This leaves an unpaired electron at the C_5 and, to fit the observed spectrum, this electron has been assumed to have a hyperfine interaction of 20.5 G with the three identical protons of the metal group and 37.7 G with the two identical protons of the C_6 methylene group. To prove that the radical postulated is responsible for the spectrum observed, partial deuteration of thymine was conducted. It was concluded that the same radical was observed in DNA as in irradiated thymine. Further experiments were done which showed that in DNA itself the hyperfine interaction arises from an interaction with the methyl protons. By growing E. coli $15T^-$, which required thymine for growth, upon normal thymine, and in a second experiment upon the deuterated thymine, the bacteria produced DNA, incorporating the two different kinds of thymine. In one DNA the thymine was normal, while in the other the thymine contained the deuterated methyl group. Irradiating both of these DNA's with uv light, and measuring the electron spin resonance spectrum, showed that the DNA extracted with normal thymine has a satellite structure in its resonance spectrum extending over 135 G and that it contains three lines on each side of the center. DNA extracted from E. coli grown on deuterated thymine showed only one satellite on each side of the main line, and the separation of that satellite was the same as in the deuterated thymine. Thus the thymine resonance observed in DNA after irradiation also arises from an electron interacting with the methyl group of thymine. (BBB)

30284 THE OXIDATION OF SAFRANINE T IN AQUEOUS SOLUTIONS BY GAMMA-RADIATION PRODUCED OH RADICALS AND BY Ce^{4+} IONS. D. G. Marketos and N. Th. Rakintzis (Nuclear Research Center Democritus, Athens). Z. Physik. Chem. (Frankfurt), 44: 270-84(Mar. 1965).

The ^{60}Co γ radiolysis of Safranine T(S) in dilute aqueous solutions, in the presence of air, was investigated. The irreversible decoloration observed is attributed to the OH radicals only. G(–S) was independent of the concentration of the dye and the dose-rate in the ranges studied from pH 3 to 5 and equal to 0.65 ± 0.01. At pH lower than 3 an increase of G(–S) was observed up to 0.79 ± 0.01 at pH 1.5. The kinetics of the decoloration were established to be first order. Study of the absorption spectra of non-irradiated and irradiated samples showed that at moderate doses only one stable irradiation product is formed. From the correlation of the difference absorption spectra of irradiation with Ce^{4+} ion oxidized samples it was concluded that the product is the same in both cases. Data obtained through stoichiometric oxidation of (S) by Ce^{4+} ions give evidence that four oxidation equivalents are utilized per mode of (S). A mechanism is proposed for the reaction of OH radical with (S) according to which an addition complex (unstable free radical intermediate) is formed as the first step of the overall reaction, which results in the uptake of four OH radicals and thus four oxidation equivalents. Changes in the UV and IR spectra are consistent with the formation of a quinone and disappearance of amino groups. (auth)

30285 THE ROLE OF HALIDE IONS IN THE RADIATION CHEMISTRY OF AQUEOUS SAFRANINE T SOLU-

TIONS. RATE CONSTANTS OF THEIR REACTIONS WITH OH RADICALS. D. G. Marketos and N. Th. Rakintzis (Nuclear Research Center Democritus, Athens). Z. Physik. Chem. (Frankfurt), 44: 285-300(Mar. 1965).

Chloride, bromide, and iodide ions were found to decrease the decoloration yield in the γ radiolysis of dilute aqueous solutions of Safranine T(S), in the presence of air; fluoride ions had no effect on G(–S). This decrease was attributed to reactions of the type $OH + X^- \rightarrow OH^- + X$ competing with (S) for the OH radicals. Thermodynamic study showed that the standard enthalpy changes of these reactions are 36.1, 6.6, –6.5, and –24.3 kcal/mole, for F^-, Cl^-, Br^- and I^-, respectively. In the case of chloride ions the above reaction is a pH dependent equilibrium, dependent on the exothermic reaction of the neutralization of the water ions. Results were also interpreted on the basis of oxidation-reduction potentials of the corresponding couples, by using the recently reported value –1.25 v of the standard oxidation potential (at pH 14) of the couple OH^-/OH. An additional small pH effect on G(–S) was also observed. By competition experiments carried out in the presence of Cl^-, Br^-, and I^- ions it was found that these ions compete for the OH radicals produced in the radiolysis of water in the ratios $1 : 1.35 \times 10^2 : 2.12 \times 10^2$ at pH3 and that these ratios are pH dependent. It was found that labeling of (S) takes place on irradiation of aerated aqueous (S) solutions, in the presence of $^{82}Br^-$ ions. The yield of the overall bromination, based on the assumption that only one Br atom enters per molecule of (S), was found to be 32.7%. (auth)

30286 THE IONIZATION AND DISSOCIATION OF ALIPHATIC KETONES UNDER ELECTRON IMPACT. II. METHYL-sec-BUTYLKETONE AND METHYL-tert-BUTYLKETONE. Motoyoshi Hatada and Kozo Hirota (Japanese Assn. for Radiation Research on Polymers, Osaka and Osaka Univ.). Z. Physik. Chem. (Frankfurt), 44: 328-34(Mar. 1965).

Ionization potentials and positive charge distribution of group-bonds of methyl sec-butyl ketone and methyl tert-butyl ketone were calculated by an extended group-bond orbital method. The calculated ionization potentials of these ketones agreed well with the observed ones. The calculated positive charge distributions showed relatively good correspondence to the bond scission probabilities obtained from the mass spectra. (auth)

30287 RADIOLYSIS OF IRON IONS IN SULFURIC ACID SOLUTIONS. Kuan-lin Huang and L. T. Bugaenko (Moscow State Univ.). Zh. Neorgan. Khim., 10: 745-50(Apr. 1965). (In Russian)

Investigations on the radiolytic transformation of Fe^{2+} ion in 0.4 to 17.3 M sulfuric acid under the effects of x and γ irradiation showed that at all concentrations of the acid oxidation of the Fe^{2+} to Fe^{3+} ion occurred. It was found that in the solutions saturated with air and oxygen, the oxidation yield of the iron decreases from 15.6 ions in 0.4 M to 12.7 ions (100 ev in 17.3 M H_2SO_4) with increasing acid concentration. In the absence of oxygen (solutions saturated with nitrogen and hydrogen) the oxidation occurs with yields from 1.9 to 1.8 times smaller (in dependence on the acid concentration) than in the presence of oxygen. It was found that the oxidation yield of iron decreases with increasing concentrations of trivalent iron ions. (tr-auth)

30288 NUCLEAR PARAMAGNETIC RESONANCE IN ORIENTED POLYMERS. III. POLYOXYMETHYLENE OF RADIATIVE POLYMERIZATION. I. Ya. Slonim, Ya. G. Urman, A. D. Ermolaev, and M. S. Akutin (Scientific-Research Inst. of Plastics, USSR). Zh. Strukt. Khim., 6: 192-7(Mar.-Apr. 1965). (In Russian)

Nuclear paramagnetic resonance spectra of monocrystalline and polycrystalline polyoxymethylene produced by solid-phase radioinduced polymerization at –196°C were studied at various specimen positions in magnetic fields. The angular dependence of the monocrystal second moment ΔH_2^2 coincided in the first approximation with the structure determined by x-ray studies. A certain divergence between the ΔH_2^2 experimental and theoretical values is explained by the anisotropic molecular motion. An expression was obtained for the function of the line form g(h) for isolated nuclear pairs in the case of a uniform distribution of intranuclear vectors on the conic surface. The line width SH calculated as a function of the angle between the axis of the crystal and magnetic field was in agreement with the experiment. (tr-auth)

30289 ELECTRON-PARAMAGNETIC RESONANCE STUDIES OF OXYGEN REACTION WITH THE PRODUCTS OF RADIOTHERMAL MODIFICATION OF POLYETHYLENE. I. THERMAL TREATMENT AT 750°C. A. D. Grishina and N. A. Bakh (Inst. of Electrochemistry, Academy of Sciences, USSR). Zh. Strukt. Khim., 6: 198-203 (Mar-Apr. 1965). (In Russian)

The oxygen reactions with the products of radiothermal modifications of polyethylene, which appeared with oxygen adsorption as a function of concentration of paramagnetic centers and the influence of oxygen on the shape of spectral lines were studied in order to determine the structure of the materials. Separate regions of prevailing polyconjunctions similar in structure appeared with deep radiative action in high-pressure polyethylene treated at temperatures up to ~800°C. The data on the structure of the products were used for determining their electric properties. (tr-auth)

30290 EPR STUDIES OF OXYGEN REACTIONS WITH PRODUCTS OF RADIO-THERMAL MODIFICATIONS OF POLYETHYLENE. II. THERMAL TREATMENT AT 800 TO 1100°C. A. D. Grishina and N. A. Bakh (Inst. of Electrochemistry, Academy of Sciences, USSR). Zh. Strukt. Khim., 6: 204-8(Mar.-Apr. 1965). (In Russian)

It was found that the structural changes in the polyconjunction region of radiothermal polyethylene modifications begin at >800°C. Continuous thermal treatment at ~900°C produced EPR spectrum characteristics indicating high-conductivity products with conductivity similar to graphite. (R.V.J.)

30291 GAMMA RADIATION CHEMISTRY OF LIQUID MIXTURES OF CCl_4 AND CYCLOHEXANE. E. Heckel. Thesis, Berlin, Technische Universitat, 1964. 54p. (In German). $2.00(Gmelin, AED-DISS. 64-314).

Gamma irradiation of CCl_4–cyclohexane mixtures resulted in chain reactions, which led to the production of chloroform and cyclohexyl chloride. Chains were started by free trichloromethyl and cyclohexyl radicals, which were produced by radiolysis. Activation energy of the reaction was 9.6 kcal/mol. Yields of various final products are given. (Gmelin Inst.)

30292 IRRADIATION OF CRYSTALLIZED HIGH-POLYMERS WITH INTERMEDIATE ENERGY ELECTRONS. STUDIES WITH PARAFFIN, POLYETHYLENE, AND POLYOXYMETHYLENE SINGLE CRYSTALS. H. Orth. Thesis, Mainz, Universitat, 1964. 121p. (In German) $2.00 (Gmelin, AED-DISS 64-316).

Electron diffraction studies of paraffin, polyethylene, and polyoxymethylene single crystals for analysis of lattice defects produced by irradiation with 40-kev electrons are described. Temperature dependence of the effects are given. (Gmelin Inst)

30293 THERMAL TREATMENT AND ELECTRON IRRADIATION OF RIBONUCLEIC ACID. E. Schaeffner. Thesis, Mainz, Universitat, 1964. 81p. (In German). $2.00(Gmelin, AED-DISS. 64-317).

The effect of thermal treatment of ribonucleic acid (RNA) in aqueous solutions was compared with the effect of 50 Mrad of 1-Mev electrons. Irradiation effects depended on the concentration of the RNA solution. Various reaction mechanisms are discussed. (Gmelin Inst.)

30294 FULL RECESS GLOVED BOX (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Berkeley). 65 drawings. (CAPE-1043)

The full recess gloved box is designed to protect the operator while he is performing low level radioactive

chemistry work. The box, which is placed inside a 2 in. lead shield, is used with remotely operated equipment. (For Details, See TID-4100) (P.C.H.)

30295 POLYSILOXANES. (to General Electric Co.). British Patent 980,101. Jan. 13, 1965. Priority date Dec. 18, 1961, United States.

A method is described for the preparation and polymerization of cyclopolysiloxane. The siloxane was prepared by reacting the compound $HO-(C_6H_5)_2Si[O-(C_6H_5)_2Si]_n O-(C_6H_5)_2Si-OH$ with a methylalkyldichlorosilane having the formula CH_3RSiCl_2 where R is a methyl, ethyl, or propyl radical in the presence of a hydrogen halide acceptor and in the presence of an inert solvent. The reaction was carried out at a temperature of 15 to 25°C with temperatures up to 120°C not precluded. Time required for affecting reaction varied from 1 to 24 hr. After the reaction was complete, the reaction mixture consists of a solution of the siloxane together with any unreacted starting materials and a hydrohalide precipitate. The precipitate was extracted with water and the filtrate remaining after the precipitate was removed was stripped of solvent and volatile starting materials resulting in a crude product. The product was recrystallized from a suitable solvent. The product could be polymerized by maintaining it at a temperature of 300 to 375°C for a time sufficient to effect rearrangement and condensation to a polymer of the desired molecular weight. Catalytic rearrangement and condensation was also applicable. These polymers were best cross-linked by ionizing radiation to produce silicone rubbers. (B.L.M.)

30296 IMPROVEMENTS IN OR RELATING TO CATALYSTS. (to Siemens-Schuckertwerke AG). British Patent 980,126. Jan. 13, 1965. Priority date Feb. 16, 1962, Germany.

A method is described for increasing the activity of a catalytic material by irradiating the material with high energy radiation (10 kev to 10 Mev) in order to produce defects in the crystal lattice prior to using the material. The material is irradiated in the form of powder, granules, or filaments and after irradiation is shaped by compacting to form a gas-diffusion electrode that catalyzes an electrochemical reaction. The depth of penetration of the irradiation by deuterons and/or protons, fast neutrons, or fast electrons is sufficiently great to reach the site of the three-phase boundary that is formed during use of the electrode. The temperature of the material during irradiation is kept below the temperature at or above which substantial annealing of the defects occurs. (B.L.M.)

30297 IMPROVEMENTS IN THE PRODUCTION OF POLYOXYMETHYLENE POLYMERS. (to W. R. Grace and Co.). British Patent 983,673. Feb. 17, 1965. Priority date May 29, 1962, United States.

A method is described for producing high molecular weight polyoxymethylene by irradiation of trioxane with 0.001 to 10 megarads of high energy ionizing radiation. Commercial trioxane (bulk density of 0.70–0.75 g/cm³) is compacted by melting and solidifying to a solid mass or by subjecting the particulate trioxane to a compressive force of at least 14 kg/cm³ to form trioxane of a bulk density above 1.0 g/cm³ before irradiation. The irradiated trioxane is heated to a temperature range of 30–62°C to polymerize it. Any unpolymerized trioxane is removed by evaporation or solvent extraction and may be recompacted for reuse. (B.L.M.)

30298 POLYMERIZATION OF OLEFINS WITH RADIATION. Grosmangin, Jacques; Besancon, Bernard; Petit, Jean C. (to Compagnie Francaise de Raffinage). Canadian Patent 707,315. Apr. 6, 1965. Priority date Apr. 6, 1962, France.

The polymerization of olefins, particularly ethylene under the action of various ionizing irradiations techniques is enhanced in the presence of ammonia as a catalyst. The optimal quantity of ammonia falls generally in the range of 3 to 10 mole per cent, preferably about 6 mole per cent when operations are conducted at a normal ambient temperature. However, increasing the operating temperature also increases the conversion speed and the molecular weight of the polymer produced. Using this method, the unpolymerized ethylene monomer and any residual ammonia are readily separated from the polymerized product by simple degasification. The polyethylene product obtained is crystalline, mp 110–125°C, density 0.935 g/cc, and a tensile strength of 190–210 kg/cm². Gamma radiation from a ^{60}Co source is preferred. Reactions can be achieved in simple autoclaves or in reactors. Extremely pure ethylene and ammonia enhance the polymerization reaction. (F.S.A.)

Radiochemistry

See also Separation Processes and Procedures.

Refer also to abstracts 30407, 30514, 30542, and 30543.

30299 (CEA-Bib-42) LES METHODES CHIMIQUES DE CONTROLE DES EFFLUENTS LIQUIDES CONTENANT DES ELEMENTS RADIOACTIFS À L'ETAT DE TRACES. (Chemical Methods For Control of Effluents Containing Radionuclides in Trace Amounts). Frydman, Alberte (Commissariat à l'Énergie Atomique, Saclay (France). Centre d'Études Nucléaires). Apr. 1965. 84p. Dep.(mn).

This bibliographical study on the monitoring of so-called inactive effluent containing traces of radioelements gives a number of publications (1960-1964) describing separation methods and of measurement or direct identification of the radioelements probably present in trace quantities. (99 references). (auth)

30300 (IFA/CO/29) TRITIUM: MEASUREMENT AND PREPARATION OF LABELLED MOLECULES. A Bibliography. Constanta Mantescu and Ana Genunche (Institutul de Fizica Atomica, Academia R. P. R., Bucharest). 1964. 110p. Dep.(mn).

A bibliography of 588 references from published literature up to the end of 1964, is presented on tritium detection and measurement and on the preparation of tritium-labeled molecules. Subject and author indexes are included. (D.L.C.)

30301 (ORNL-3789(p.277-86)) BEHAVIOR OF RADIOIODINE. (Oak Ridge National Lab., Tenn.).

Radioiodine, prepared by decomposition of palladium iodide or by action of dichromate upon alkali iodides, can be separated by distillation at −78°C into two fractions. The less-volatile fraction appears to consist almost entirely of molecular iodine. The more-volatile fraction, which is of interest because of its similarity to forms of I which occur in reactor accidents, has been examined by partition between water and organic solvent, by Knudsen effusion cell techniques, by gas chromatography, by mass spectrometry, and by use of composite diffusion tubes. Experimental results indicate this fraction to consist primarily of methyl iodide. Reaction of radioiodine and the vapors of complex organic materials (such as lubricating oil, paint, rubber and plastic insulation, and dioctyl phthalate, DOP) likely to be found in reactor environments occur at room temperature. As much as 10% of the radioiodine was converted to organic iodide compounds. Iodine is removed from $He-H_2O$, H_2-H_2O, and H_2O–air atmospheres by heated mild steel surfaces. Composite diffusion tubes were employed in evaluating the performance of components of samplers (May packs) designed to discriminate between the various forms of gas-borne radioiodine. The behavior of volatile I in two May packs, one operated with fairly dry air and one operated with moderately moist air, was observed to be generally consistent with the designed functions of the May pack components. The retention of methyl iodide and of I_2 by activated charcoals was studied as functions of temperature and relative humidity over a wide range. (J.R.D.)

30302 (ORNL-3789(p.287-9)) BEHAVIOR OF RADIOACTIVE AEROSOLS. (Oak Ridge National Lab., Tenn.).

A program is under way to improve techniques for the

study of radioactive aerosols, and to provide effective and easy-to-handle aerosols that will simulate, in their behavior in filter systems, the radioactive species released in nuclear accidents. Effective testing of I removal systems of the NS Savannah and of the ORR was accomplished with elemental I. Promising simulated dispersions of particulate materials were prepared in arcs struck between electrodes of UO_2. These simulants were used in tests of the efficiency of absolute filters. A technique for studying radioactive aerosols, using fibrous filters, was refined and is being used to test filtration theory. When this program has been carried further, it is anticipated that materials and techniques will be available which will permit a valid in-place demonstration of the reliability of an engineered safeguard. (auth)

30303 A MODIFIED PROCEDURE FOR LABELING OF OVALBUMIN WITH CHROMIUM. Maria Kavai and Lorand Kesztyues (Medical Univ., Debrecen, Hungary). Acta Microbiol. Acad. Sci. Hung., 9: 349-54(1962-3). (In German)

Ovalbumin was incubated at 22°C for 24 hr with an ammoniated solution of $CrCl_3$. The mixture was dialyzed against distilled water at 4°C. In the purified labeled ovalbumin the mole ratio of protein to Cr was 1 : 25. The amount of unbound Cr in the mixture was measured by the use of ^{51}Cr. The Cr appeared to be bound by the peptide bonds in the protein, and the number of polar groups was essentially unaltered by the treatment. Viscosity measurements of the ovalbumin and the Cr ovalbumin showed only a small difference between the two, suggesting that the labeling procedure produced min denaturation of the protein. The amount of ovalbumin precipitable by $(NH_4)_2SO_4$ increased with the temperature at which the ovalbumin and Cr were incubated, and with the mole ratio of ovalbumin to Cr. The electrophoretic mobility of Cr ovalbumin was very close to that of ovalbumin. (BBB)

30304 SPATIAL ENERGY DISTRIBUTION AND DOSAGE OF γ RADIATION FROM A MONODIRECTIONAL AND ISOTROPIC ^{60}Co SOURCE AT THE EARTH-AIR BOUNDARY. S. M. Ermakov, B. A. Efimenko, V. G. Zolotukhin, Yu. A. Kolevatov, and V. I. Kukhtevich. At. Energ. (USSR), 18: 416-18(Apr. 1965). (In Russian)

Results are given of the measurements and Monte-Carlo calculations of spatial and energy distribution of scattered γ radiation from a mono-directed ^{60}Co source (at mean energy of 1.25 Mev) at 15 to 30 m source-detector distance and identical detector and source elevation (2, 10, 30, and 53 m) over the ground. The measurements and calculations were carried out at two angles (60 and 90°) of point source orientation. (R.V.J.)

30305 ABSOLUTE COUNTING OF RADIONUCLIDES BY THE BETA-GAMMA COINCIDENCE METHOD USING A LIQUID SCINTILLATOR AS INTERNAL BETA DETECTOR. G. Erdtmann and G. Herrmann (Universitat, Mainz). Intern. J. Appl. Radiation Isotopes, 16: 301-18 (May 1965). (In German)

The sources of errors and the accuracy of this method were investigated. In spite of the large sample volume the local dependence of counting efficiency in the β and γ detectors introduced no serious error if the detectors were arranged in a certain symmetrical manner. Corrections, however, had to be applied for incomplete detection of low-energy β decay branches and for the γ sensitivity of the β detector, either by graphical extrapolation or, more generally, by calculation of a correction factor. This calculation is explained for typical decay schemes. A formula is given for the statistical error of the disintegration rate, which involves detector backgrounds. Several nuclides were standardized by the procedure outlined here as well as by β-γ coincidence counting using a 4π proportional counter; some of the samples counted were standardized at other laboratories, too. The results compare excellently. However, decay rates found in liquid scintillation counting were found to be too low if only the β rays were assayed. By use of liquid scintillators standardizations can be simplified. Aqueous solutions may be added directly, and even considerable amounts of carrier and bulk elements may not interfere. (auth)

30306 A Sr^{87m} GENERATOR FOR MEDICAL APPLICATIONS. J. F. Allen and J. J. Pinajian (Oak Ridge National Lab., Tenn.). Intern. J. Appl. Radiation Isotopes, 16: 319-25(May 1965). (ORNL-P-724)

A ^{87m}Sr generator for producing mC quantities of carrier-free, radiochemically pure ^{87m}Sr suitable for medical use is described. The parent activity, ^{87}Y, was produced in the ORNL 86-in. cyclotron by the $^{87}Sr(p,n)^{87}Y$ reaction with a yield of 8.4 mC hr^{-1} at a beam current of 86 μamp. The ^{87}Y was isolated by carrying it with ferric hydroxide. The carrier-free ^{87}Y in the carbonate form was adsorbed on an ion-exchange resin and the ^{87m}Sr daughter activity eluted, as needed, by passing 0.01 M $(NH_4)_2CO_3$ solution through the column. Carrier-free ^{87m}Sr, free of any other cationic species, was prepared by evaporating the ammonium carbonate. No radiocontaminants were detected in the ^{87m}Sr (limit: 5×10^{-5} μC, corresponding to 5×10^{-7}% with a 10 mC generator). The general equations relating to the relative activities and the time required for the maximum growth of the daughter are given. (auth)

30307 AN IMPROVED TECHNETIUM-99m GENERATOR FOR MEDICAL APPLICATIONS. J. F. Allen (Oak Ridge National Lab., Tenn.). Intern. J. Appl. Radiation Isotopes, 16: 332-4(May 1965). (ORNL-P-838)

^{99m}Tc was separated from radioactive impurities, such as ^{103}Ru and ^{132}I, by solvent extraction using methyl ethyl ketone. The product had 799.99% radiochemical purity. The short-lived ^{99m}Tc is obtained from the longer-lived ^{99}Mo parent by fixing the parent on alumina in an ion-exchange column from which the daughter activity may be repeatedly milked. (M.C.G.)

30308 THE IMPURITY OF RADIOIODINATED TRIOLEIN. Kennedy, J. A.; Kinloch, J. D. (Glasgow Royal Infirmary). J. Clin. Pathol., 17: 160-2(Mar. 1964).

During investigation of a case of steatorrhoea using ^{131}I-triolein, an inconsistency in the results was found. It was thought that the error might have been due to the faulty labeling of triolein with ^{131}I by the method used. On analysis of the end product by thin-layer chromatography a considerable amount of impurity was found and the source was traced to the synthetic triolein supplied commercially; commercially supplied ^{131}I-triolein was found to contain similar impurities. Consequently more detailed studies of ^{131}I-triolein, as supplied commercially in carrier olive oil, were performed using silicic acid column chromatography. The autoradiogram of the chromatogram of the ^{131}I-triolein in olive oil showed several radioactive impurities. The main impurity was present as diglycerides and little radioactivity appeared to occur in the free fatty acid. This finding was confirmed by the stained chromatoplate. The nature of one unidentified spot in the autoradiogram remained obscure. It was thought that it might be due to a triglyceride with a polyunsaturated side chain, but this was not confirmed by liquid gas chromatography. The results of radioanalysis of the column fractions are discussed. Ir analysis failed to reveal the presence of lower glycerides in either synthetic triolein or in the ^{131}I-triolein in olive oil, although it verified the presence of lower glycerides in the methanol fraction of the silicic acid column. It was concluded that about 30% of the total radioactivity of a commercial sample of ^{131}I-triolein is present in a diglyceride impurity; there is little radioactivity in the free fatty acid. (BBB)

30309 RADIOCHEMICAL STUDY OF ADSORPTION BEHAVIOR OF INORGANIC IONS ON ZIRCONIUM PHOSPHATE, SILICA GEL, AND CHARCOAL. Eiko Akatsu (Japan Atomic Energy Research Inst., Tokyo), Reiko Ono, Kuniko Tsukuechi, and Hirokatsu Uchiyama. J. Nucl. Sci. Technol. (Tokyo), 2: 141-8(Apr. 1965).

Adsorption behavior of inorganic ions was systematically surveyed through radiochemical methods. The adsorbents used were zirconium phosphate, silica gel and charcoal, and the aqueous phases were $0.01_N - 10_N$ nitric acid and $0.01_M - 10_M$ ammonium nitrate solutions. The distribution ratios of

about 50 chemical elements from Na to Cm were determined by the batch method using radioactive tracers. In the zirconium phosphate system, Cs shows the highest Kd value, and most bivalent species are not adsorbed. A few elements are adsorbed on silica gel from acid solution. High Kd values are shown by Zr, Nb, and Pa. In the charcoal system, most chemical elements are adsorbed to some extent except for alkali and alkaline earth ions. (auth)

30310 RESOLVING PARENT-DAUGHTER MIXTURES OF RADIONUCLIDES WITH STRAIGHT-LINE FORMS OF EQUATIONS FOR GROWTH AND DECAY. John D. Buchanan (Hazelton-Nuclear Science Corp., Palo Alto, Calif.). Radiochim. Acta, 4: 28-32(May 1965).

Straight-line forms of equations for the measured growth-decay of radionuclide mixtures were developed for the general case of a parent-daughter mixture; for a number of special cases of parent-daughter mixtures; and for a parent-daughter plus a third, independent activity. These straight-line equations were used for resolving the components of the mixtures, and for determining counting efficiencies and ratios of counting efficiencies. Applications of the equations are described for commonly encountered systems. (auth)

30311 CHEMICAL REACTIONS OF ^{76}As RECOIL ATOMS FROM THE (N, GAMMA) CAPTURE IN ARSENIC TRICHLORIDE. W. Roebke, H. Drawe, and A. Henglein (Hahn-Meitner-Institut fur Kernforschung, Berlin). Radiochim. Acta, 4: 39-44(May 1965). (In German)

The $^{76}AsCl_3$ retention in liquid and gaseous arsenic trichloride amounts to 100%. Oxygen decreases the retention in the gas phase by formation of arsenic pentoxide. In mixtures with cyclohexane, labeled cyclohexyldichloroarsine as well as dicyclohexylchloroarsine were produced. Their yields became appreciable only if arsenic trichloride was present at low concentration. The organic compounds were more frequently formed in the liquid than in the gas phase. Their yields in the gas increased with increasing dose rate of the γ rays accompanying the neutron radiation, while they were independent on dose rate in the liquid. Up to 95% of the cyclohexane in the gaseous mixtures could be substituted by krypton or some other gases without changing the yields of the organic arsenic compounds. The retention was explained by fast chlorine transfer process between arsenic trichloride and ^{76}As atoms or partly chlorinated ^{76}As atoms. Organic compounds were produced in reactions of cyclohexyl radicals with ^{76}As atoms. The results indicated that the effective cyclohexyl radicals were produced by the γ radiolysis of the hydrocarbon in the gas phase and by the decomposition of molecules close to n,γ capture in the liquid. All products were formed by reactions of practically thermalized ^{76}As recoil atoms. To complete the recoil experiments, the exchange of ^{76}As atoms between labeled metallic arsenic and arsenic trichloride was studied. (auth)

30312 CHEMICAL SECONDARY REACTIONS AFTER THE BETA DECAY OF Ge-TETRAPHENYL. H. J. Riedel, and E. Merz (Kernforschungsanlage, Julich, Ger.). Radiochim. Acta, 4: 48-51(May 1965). (In German)

The distribution of radioarsenic among the various products was investigated in the β decay of ^{77}Ge-tetraphenyl. The separation of the radioactive products was achieved by adsorption chromatography on alumina, ion exchange, and electrophoresis and their yields determined. The results were then compared with those of the (n,γ) reaction on As-triphenyl and Ge-tetraphenyl. The β^- decay on ^{77}Ge-tetraphenyl produced practically the same chemical compounds as were observed by nuclear reactions. However a remarkable increase in the portion of the labeled parent molecules (retention) was typical for the beta transition indicating a high percentage of non-bond rupture. The influence of foreign species, which act as scavengers, was also investigated. (auth)

30313 RECOIL EFFECTS OF ^{60}Co FOLLOWING (n,γ) REACTION IN TRISACETYLACETONE Co(III) AND IN DILUTED SYSTEMS. J. Shankar, K. S. Venkateswarlu, and Manohar Lal (Atomic Energy Establishment, Trombay, India). Radiochim. Acta, 4: 52-5(May 1965).

The results of ^{60}Co recoil in triacetylacetone Co(III) and in its dispersions in the corresponding complexes of Al(III), Rh(III), and Mn(III) are described. The aspects studied include the experimental determination of inherent retention, nuclear isomer effect, and electrophoretic behavior on dissolution of the neutron-irradiated complexes. (auth)

30314 ALKYL IODIDE–IODINE EXCHANGE AND THE SZILARD-CHALMERS EFFECT. E. D. Cohen and C. N. Trumbore (Univ. of Delaware, Newark). Science, 148: 1460-1(June 11, 1965).

The rate of isotopic exchange between liquid ethyl iodide and dissolved iodine is of zero order with respect to iodine concentration. Apparent isotopic exchange is thus very rapid at low concentrations of iodine, and previously reported values of organic retention, obtained in studies of (n,γ) recoil in alkyl iodide, are placed in doubt. (auth)

30315 A CONVENIENT SYNTHESIS OF VITAMIN D_3-9, 19-^{3}H AND THE MECHANISM OF THE PREVITAMIN D_3 ⇌ VITAMIN D_3 REACTION. M. Akhtar and C. J. Gibbons (Univ. of Southampton, Eng.). Tetrahedron Letters, No. 9, 509-12(Mar. 1965).

As an intermediate for the previtamin D_3 ⇌ vitamin D_3 reaction, 19-tritiated cholesterol was synthesized as follows. 19-Tosyl cholesteryl acetate with sodium iodide in boiling ethyl methyl ketone gave the 19-iodide which on reduction with zinc in the presence of tritiated water, containing a trace of acid, gave cholesteryl acetate-19-^{3}H. The latter gave 7-dehydrocholesterol-19-^{3}H (I) which on photolysis yielded previtamin D_3-19-^{3}H (II) and this on thermal rearrangement gave tritiated vitamin D_3 (III) isolated as its 3,5-dinitrobenzoate. Radioactivity measurements revealed that no significant amount of label was lost during the conversions and II → III. Furthermore, a sample of tritiated vitamin D_3 3,5-dinitrobenzoate after being refluxed for two hr in methanol-benzene showed no loss of radioactivity. These results established the previously postulated mechanism in which the conversion II ⇌ III takes place through an intramolecular hydrogen transfer. On ozonolysis, vitamin D_3-9,19-^{3}H (III) gave formaldehyde which was isolated as its dimedone derivative and which had 48% of the radioactivity of III. III on oxidation with acidic potassium permanganate gave a ketone which was isolated as its semicarbazone derivative and which had only 3% of the radioactivity of III, most of the label having been lost during oxidation. From these experiments it is concluded that thermal equilibration of II and III takes place through intramolecular hydrogen transfer and the transition state leading to this process is non-stereospecific. (BBB)

Separation Processes and Procedures

See also Analytical Procedures.

Refer also to abstracts 30130 and 31462.

30316 (AERE-R-4440(Pt.2)) REPROCESSING WITH AMINE–ETHER SYSTEMS. PART 2. DISTRIBUTION COEFFICIENTS. Jenkins, I. L.; McKay, H. A. C.; Shorthill, C. G. C.; Wain, A. G. (Atomic Energy Research Establishment, Harwell (England)). May 1965. 17p. Dep.; $0.50(BIS); 2s. 6d.(HMSO).

Results have been obtained for the extraction of uranium, plutonium, nitric acid, and fission products into tertiary amines in ether diluents, and for the backwashing of plutonium from the organic phase. Most of the work has been with a solution of Alamine 336 in dibutyl cellosolve (DBC). The results show that the preferential extraction of plutonium from a mixture of plutonium, uranium, and fission products is feasible, and that acetic acid–nitric acid mixtures can be used for backwashing. (auth)

30317 (BNWL-72) RUTHENIUM REMOVAL FROM INTERMEDIATE LEVEL RADIOACTIVE WASTES BY

ELECTRODIALYSIS METHODS. L. F. Coleman and J. R. Eliason (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1, 1965. Contract AT(45-1)-1830. 27p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Electrodialysis was demonstrated to be capable of removing ruthenium from nitric acid wastes, but the economics for removing greater than 90 percent of the ruthenium activity by only an electrodialysis step are not considered favorable. Electrodeionization through packed resin beds (a special application of electrodialysis) was shown to be a feasible and economical method for removing ruthenium from acid and alkaline process condensates containing on the order of 500 ppm dissolved solids. Laboratory results show that 95 percent of the ruthenium can be removed from acidic and alkaline condensates at up to fiftyfold volume reductions. (auth)

30318 (CEA-R-2761) INSTALLATIONS SOUS-CRITIQUES D'EVAPORATION CONTINUE JUSQU'A 200 LITRES/HEURE. DESCRIPTION ET RESULTATS EXPERIMENTAUX. (Subcritical Installations for Continuous Evaporations of up to 200 Liters/Hour — Description and Experimental Results). Pierre Auchapt, Georges Bouzou, Roger Sautray, and Max Jacquotte (Commissariat à l'Énergie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Feb. 1965. 70p. Dep.(mn).

Presented are a detailed technological description and the test results obtained with two continuous evaporation units, one of 16 l/hr, the other of 65 l/hr. These installations are sub-critical with multiplication factors (k_{eff}) for total reflection of 0.73 and 0.77. A third evaporator of 200 liters, also sub-critical (k_{eff} = 0.90), is given as the limiting possible case. A description is also given of simple devices without regulator for maintaining a constant level in an extra flat separator, thus making it possible to operate without supervision in perfect safety at any concentration factor. The liberal thermal characteristics and the simple operational principles constitute a sure guarantee for operation in α and γ conditions. (auth)

30319 (COO-770-11) SEPARATION OF CESIUM AND STRONTIUM BY ELECTRODIALYSIS. H. C. Hershey, R. D. Mitchell, and W. H. Webb (Missouri School of Mines and Metallurgy, Rolla. Dept. of Chemical Engineering and Chemistry). [1962]. Contract AT(11-1)-770. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The problem of separating Cs and Sr from each other in electrodialyzed fractions of fission product solutions was considered. Studies were conducted in which EDTA and DTPA were used to form negatively charged Sr complexes, while Cs remained as positively charged ions. A two-cell and a three-cell electrodialyzers were used, and carrier solutions with added ^{90}Sr or ^{137}Cs were used as feed solution. The results show that quantitative separation of Sr from Cs is possible using cation exchange membranes in the cells. (D.L.C.)

30320 (DP-849) PURIFICATION OF RADIOACTIVE SOLVENT WITH A FLASH VAPORIZER. H. J. Clark and G. S. Nichols (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Apr. 1965. Contract AT(07-2)-1. 17p. (CONF-611001-1). Dep.; $1.00(cy), 1(mn) CFSTI.

From 1st Inter-American Congress of Chemical Engineers, San Juan, Puerto Rico.

A flash vaporization technique using superheated steam for decontaminating and improving the quality of degraded tributyl phosphate–kerosene solvent from a radiochemical separations plant was studied. The equipment is simple, requires a residence time of less than one second, and has satisfactory operating characteristics over a wide range of variables. The two 100-gallon charges of degraded solvent were processed through the test equipment at 100 pounds per hour with a 98 to 99% yield. The distillate contained less than 4% of the fission products present in the feed. (auth)

30321 (IS-1153) ANION EXCHANGE SEPARATIONS OF THE RARE EARTHS IN NONAQUEOUS SOLVENTS. Greene, Richard G.; Fritz, James S. (Ames Lab., Iowa State Univ. of Science and Tech.). Feb. 1965. Contract W-7405-eng-82. 87p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Many metal ions were separated from the rare earth elements using a nitrate-form anion-exchange column. This was accomplished by eluting the various metals from the more highly sorbable rare earths with 1.5M nitric acid in 85% isopropyl alcohol. The higher rare earths can be eluted from the column using lower percentages of isopropyl alcohol and separated from bismuth(III), lead(II), and thorium(IV), which remain on the column. A study was made of the conditions necessary to separate various rare earths from each other using anion-exchange techniques. This was accomplished by determining the distribution coefficients of various rare earths as a function of concentration of organic solvent, nitric acid, and lithium nitrate. Various organic solvents were studied. Separation factors were determined in a solvent mixture of 92.5% methanol–3.00M lithium nitrate–0.95M nitric acid and were found to compare favorably with separation factors obtained by investigators using different systems. Invasion (the sorption of significant amounts of electrolyte by an ion exchanger) of anion-exchange resin by lithium nitrate and nitric acid from organic–water solvent mixtures was studied. It was concluded that the solubility of an electrolyte in the solution being equilibrated with the resin is an important factor in determining the extent of invasion. The Donnan potential concept was used in explaining some of the results. Mean ligand numbers for various metal ions with the nitrate ligand were determined in water–organic solvent mixtures using ion-exchange techniques. The mean ligand numbers were determined in the anion-exchange resin phase as well as in the solution phase. The ligand numbers were found to increase in going from the solution to the resin phase. The metal ions studied did not appear to reach their saturated coordination number in the resin phase. (auth)

30322 (ORNL-3527) ENGINEERING DEVELOPMENT OF A FOAM COLUMN FOR COUNTERCURRENT SURFACE-LIQUID EXTRACTION OF SURFACE-ACTIVE SOLUTES (thesis). Haas, P. A. (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 245p. Dep.(mn); $6.00(cy), 5(mn) CFSTI.

Submitted to Univ. of Tennessee, Knoxville.

The foam separation process uses differences in surface activity to effect the separation of components of a solution. Engineering problems were solved and methods developed for the design and operation of countercurrent liquid-foam columns. Six- and 24-in.-ID columns were operated to measure contacting efficiency, foam densities, foam drainage, and foam condensation. The experimental results agree with a model for countercurrent liquid-foam flow based on capillary flow through the Plateau borders between foam bubbles. Data for the drainage of the liquid from the foam flowing vertically or horizontally also agree with the same model. The heights of transfer units based on the liquid phase (HTU_x) were about 1 cm for the best conditions of uniform foams of 0.56- to 1.0-mm bubble diameter, liquid flows of 100 gal/ft²-hr or less, and uniform liquid feed distribution with low inlet velocities. The ability of gas spargers to give uniform foam bubbles was important; spinnerets with 50- or 80-μ-dia holes as used by the rayon industry were superior to porous metal or fritted glass. There was little variation in HTU_x values for countercurrent column lengths of 10 to 28 cm. The major effects of liquid and foam flow rates and of liquid feed distributors on HTU_x values were due to their influence on the extent of channeling. The foams were condensed by means of orifices, air-operated sonic whistles, screen-lined centrifugal foam breakers, or cyclones. The removal of radioactive strontium to decontaminate ORNL low-level waste was shown to be practical if preceded by a precipitation step (head-end step) to decrease the calcium and magnesium concentrations. (auth)

30323 (ORNL-3789(p.306-7)) SOLVENTS FOR THE FLUORINE VOLATILITY PROCESS. R. E. Thoma and B. J. Sturm (Oak Ridge National Lab., Tenn.).

The solvent system $KF-ZrF_4-AlF_3$ seems to possess

optimum combination of low cost, high AlF_3 capacity, and low corrosivity for use in fluoride volatility processing of Al–U alloy fuels. Data were obtained to establish within 1 mole % the compositions along the 600°C isotherm for this system. $KF-ZrF_4$ and $LiF-NaF-ZrF_4$ mixtures offer promise, in dissolving high concentrations of UF_4 at 600°C, as solvents for dissolving Zr-clad UO_2 fuel elements. It is possible that the LiF–KF eutectic can dissolve sufficient FeF_2, NiF_2, and CrF_3 to serve as a medium for reprocessing stainless-steel-clad UO_2 fuels. (auth)

30324 (ORNL-TM-1139) REPROCESSING METHODS AND COSTS FOR SELECTED THORIUM-BEARING REACTOR FUEL TYPES. Roberts, J. T.; Ferris, L. M.; Nicholson, E. L.; Rainey, R. H.; Watson, C. D. (Oak Ridge National Lab., Tenn.). May 14, 1965. Contract W-7405-eng-26. 50p. Dep.(mn); $2.00(cy), 2(mn) CFSTI.

Head-end and solvent extraction processes are described for two classes of thorium-bearing power reactor fuels: (1) massive graphite elements containing pyrolytic-carbon-coated thorium–uranium oxide or carbide particles, and (2) metal-clad elements containing thorium–uranium metal, oxide, or carbide cores. Burn-leach, declad-dissolve, and shear-leach head-end methods are described in detail. Solvent extraction flowsheets for recovering both the thorium and uranium or the uranium only are presented. The technical and economic aspects of these processes, including the interim and ultimate waste disposal problems, are discussed, by comparison with processes for standard uranium fuels. (auth)

30325 (RT/FI(65)-6) A PLANT FOR HANDLING AND PURIFYING XENON. G. M. de'Munari and G. Mambriani (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan. 1965. 12p. Dep.(mn).

A plant for handling and purifying several moles of xenon is described. The plant allows one to prepare mixtures of xenon and vapors too, and from these to get back xenon of good purity. Mass spectrographic and chromatographic analyses of some samples are presented. (auth)

30326 (USNRDL-TR-836) A RAPID METHOD FOR THE CARRIER-FREE DETERMINATION OF INDIVIDUAL RARE EARTHS BY ION EXCHANGE AT ROOM TEMPERATURE. S. C. Foti and L. Wish (Naval Radiological Defense Lab., San Francisco, Calif.). Jan. 29, 1965. 17p.

A rapid procedure was devised for the quantitative recovery of the individual rare earth elements and yttrium from a synthetic mixture of carrier-free yttrium, terbium, gadolinium, europium, samarium promethium, neodymium, praseodymium, cerium and lanthanum radionuclides. The separations are accomplished in 14 hours by elution from a Dowex 50W-X4 resin column with α-hydroxyisobutyrate solutions at room temperature. (auth)

30327 THE SEPARATION OF RARE EARTHS BY PAPER ELECTROMIGRATION AND FOCUSING CHROMATOGRAPHY. Yoshiyuki Kiso, Itsuko Yamada, Yuroku Yamamoto, and Mutsuaki Shinagawa (Hiroshima Univ.). Bull. Chem. Soc. Japan, 38: 695-8(May 1965).

The optimum pH value and concentration of EDTA for separating rare earths (lanthanum, cerium praseodymium, neodymium, samarium, and yttrium) by the technique of paper electromigration were evaluated on the basis of the migration theory. The validity of the theory was then justified experimentally. The best condition for separation was in the range of pH from 1.7 to 2.1 with 5×10^{-3} M EDTA. The applicability for focusing chromatographic separation was examined with several pH arrangements between hydrochloric acid on the anodic side and an EDTA complexing agent solution on the cathodic side. It was concluded that the initial optimum pH of an anodic solution for separation may be obtained by selecting the pH range close to the expected one for the ordinary electromigration, while the effect of pH in a cathodic solution is not as important. (auth)

30328 DEGASIFICATION OF NUCLEAR GRAPHITE BEFORE AND AFTER PURIFICATION–INFLUENCE OF OXIDATION IN AIR AT 620°C. F. M. Lang and P. Magnier (Commissariat a l'Energie Atomique, Saclay, France). Carbon, 2: 7-14(Aug. 1964). (In French)

Three apparatuses were used to de-gas graphite samples over different temperature ranges: from 25 to 900°C in a current of argon, with CO and CO_2 products analyzed by infrared absorption; up to 1700°C, heating by high frequency under vacuum, with the gases being analyzed by chromatography; and above 2200°C, where the presence of carbon vapors made it necessary to use an auxiliary field concentrator. Heating was continued up to 2500°C, at which temperature sublimation led to complete opening of the closed pore structure. It was found that as a result of their manufacturing or storage conditions, nuclear graphites can release hydrogen or a gas corresponding stoichiometrically to water gas; 40% of these gases come from the closed pores and are given off at temperatures above 1750°C. Heat treating the sample in a bed of carbon black could lead to a substitution of CO by H_2. Oxidation by air opened up a large proportion of the closed pores and leads to the formation of surface oxides in proportion to the available surface. These surface oxides were not greatly influenced by inorganic impurities. The gas production by degassing after oxidation was at a maximum between 600 and 800°C and almost finished at 1000°C, but a further small increase occurred when the graphite sublimed. An oxidation to 10% weight loss was not sufficient to eliminate entirely the substances adsorbed by the graphite before oxidation at 620°C; they appeared to be deep in the carbon. (auth)

30329 CONTRIBUTION TO THE TESTING OF THE SUGGESTED SORPTION MECHANISM OF ZIRCONIUM ON SILICA GEL FROM NITRIC ACID SOLUTION. J. Rais and M. Kyrs (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Collection Czech. Chem. Commun., 30: 983-90(Apr. 1965).

The diffuse character of the sorption kinetics of zirconium on silica gel and the dependence of the sorption mechanism on the acidity of the aqueous phase was investigated. It was observed that the rate of ion exchange of zirconium between the solution and the sorbent is considerably greater in 6N HNO_3 solution than in 2N HNO_3 medium. The dependence of the distribution coefficient on the volumetric ratio of the phases and the rate of desorption by an inactive zirconium solution differs also according to the acidity of the aqueous phase. The self-diffusion coefficients of zirconium were measured in nitric acid solutions of various acidity. (auth)

30330 PARTITION CHROMATOGRAPHY OF URANIUM AND FISSION PRODUCTS ON A POROUS STYRENE-DIVINYL BENZENE COPOLYMER SWOLLEN IN TRIBUTYLPHOSPHATE SOLUTION. H. Beranova and M. Novak (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Collection Czech. Chem. Commun., 30: 1073-81 (Apr. 1965).

The distribution of uranium and of some radioactive fission products was studied on a sorbent formed by swelling styrene-divinylbenzene copolymers in tributylphosphate solution. The effects of nitric acid concentration in the aqueous phase were determined. The conditions of the separation of some fission products from uranium were found. (auth)

30331 REVERSED-PHASE CHROMATOGRAPHY OF Al, Ga, In, Tl AND THE TRANSITION METALS OF THE IRON GROUP ON PAPER TREATED WITH DI-(2-ETHYLHEXYL) ORTHOPHOSPHORIC ACID IN CHLORIDE MEDIUM. E. Cerrai and G. Ghersini (CISE, Milan). J. Chromatog. 18: 124-33(Apr. 1965).

Reversed-phase chromatography of aluminum, gallium, indium, thallium, iron, cobalt, and nickel on paper treated with di-(2-ethylhexyl) orthophosphoric acid (HDEHP) was investigated, using hydrochloric acid as the eluent in a range of concentrations from 10 to 1×10^{-4} M. The quantity $(1/R_F - 1)$ was related to the hydrogen ion activity in the mobile phase and to the effective HDEHP concentration on the paper. The chromatographic behavior was correlated with that in liquid-liquid extraction systems. Chromatographic separations of the above elements from each

other and from additional cations such as barium, calcium, titanium, strontium, manganese, yttrium, zirconium, and uranium were performed. (auth)

30332 THIN-LAYER CHROMATOGRAPHIC METHOD FOR THE SEPARATION OF RARE EARTHS. A. Daneels, D. L. Massart, and J. Hoste (State Univ. of Ghent). J. Chromatog., 18: 144-7(Apr. 1965).

A thin-layer chromatographic method was developed for separating rare earths. Silica gel was impregnated with buffers or acids and eluted with di-(2-ethylhexyl) phosphoric acid. To detect the rare earths radioactive tracers were used. It was concluded that this method should be valuable for separation of 3 to 5 adjacent rare earths. (M.C.G.)

30333 SYNERGIC EXTRACTIONS. Anil K. De (Jadavpur Univ., Calcutta). J. Sci. Ind. Res. (India), 24: 82-5(Feb. 1965).

In solvent extraction of metals by a mixture of two organic solvents the system may behave in one of three ways; neither solvent participates in the extracted metal complex (e.g. extraction of indium from hydrobromic acid with benzene + cyclohexane), one of the solvents participates whereas the other is an inert diluent (e.g. extraction of chloroauric acid by tributylphosphate + xylene), or both the solvents participate in the complex formation (e.g. extraction of uranium(VI) by thenoyltrifluoroacetone + tributylphosphate). The distribution coefficients may be higher by a few orders of magnitude than those exhibited by either of the solvents alone. This phenomenon is termed synergism. Synergic systems and the mechanism of synergistic action are described. Antisynergism is also discussed. (F.J.H.)

30334 THE SEPARATION OF SOME BI- AND TERVALENT CATIONS ON ZIRCONIUM PHOSPHATE COLUMNS. Ivan Gal and Nada Peric (Univ. of Belgrade). Mikrochim. Ichnoanal. Acta, No. 2, 251-4(1965).

On small columns filled with the inorganic cation-exchanger zirconium phosphate, separation of Zn^{2+} from Cd^{2+} (quantitative) and Ni^{2+} from Co^{2+} (partly) was carried out. The exchanger was in the NH_4^+ form, and 0.5 to 4$\underline{N}$ NH_4Cl served as eluent. With the exchanger in the H^+ form, UO_2^{2+} was separated from bivalent cations and ferric iron by stepwise elution with 0.1, 0.5, and 4$\underline{N}$ HCl solutions. (auth)

30335 RADIOCHEMICAL SEPARATION AND PURIFICATION OF THALLIUM. Rene Bimbot (Universite de Paris, Orsay, France). Radiochim. Acta, 4: 1-3(May 1965). (In French)

Thallium was separated from other elements by two chemical methods: a precipitation of thallous iodide; solvent extraction of thallic ion by diisopropyl ether; and precipitation of thallic hydroxide in the back extracted aqueous phase. The purity of the samples was controlled by the use of radioactive isotopes produced by spallation. The concentration of any impurity was less than $1/_{1000}$. (auth)

30336 THE EFFECT OF TEMPERATURE ON THE EXTRACTION OF NITRIC ACID, URANYL, AND PLUTONIUM NITRATES BY LONG CHAIN TERTIARY AMINES. P. R. Danesi, F. Orlandini, and G. Scibona (CNEN-CSN, Casaccia, Italy). Radiochim. Acta, 4: 9-12(May 1965).

The influence of temperature on the extraction of HNO_3, plutonium (IV), and uranium (VI) from nitrate solutions by long-chain aliphatic tertiary amine nitrates was studied. The ΔH for the extraction reactions were calculated. The best conditions for the plutonium-uranium separation by these extractants are indicated. (auth)

30337 SEPARATIONS OF PROTACTINIUM FROM NIOBIUM, TANTALUM AND OTHER ELEMENTS BY SOLVENT EXTRACTION USING N-BENZOYL-N-PHENYLHYDROXYLAMINE. S. J. Lyle and A. D. Shendrikar (Univ. of Durham, Eng.). Talanta, 12: 573-81 (June 1965).

The extraction of niobium, tantalum, and protactinium from hydrochloric acid solutions containing fluoride into chloroform solutions of N-benzoyl-N-phenylhydroxylamine was studied. From such aqueous systems it is possible to separate pairs or all three of these elements efficiently and in a reasonably quantitative manner. In addition, protactinium may be easily separated from zirconium (and presumably also hafnium), aluminum, titanium, manganese (II), Iron(III), rare earths, and thorium by extracting it from concentrated hydrochloric acid solutions. The back-extraction of niobium, tantalum, and protactinium into aqueous phases of various compositions and additional separations thus revealed were also considered. Phase distribution measurements and separations were performed using suitable radioactive isotopes of the elements concerned. (auth)

30338 IMPROVED METHODS FOR THE PREPARATION OF THE RARE-EARTH METALS. C. E. Habermann (Dow Chemical Co., Midland, Mich.), A. H. Daane, and P. E. Palmer. Trans. Met. Soc. AIME, 233: 1038-44(June 1965).

Several refinements in the fluoride-preparation, reduction-step, and purification techniques for the rare-earth metals, which have resulted in increased purity of the metals produced, are presented. A new method for the removal of some impurities was devised, which involves filtering liquid rare-earth metals through tungsten filters. The reduction of the heavy rare-earth carbides with lanthanum metal is also discussed as a method of preparation. Recent vapor-pressure measurements on the rare-earth metals made possible the calculation of precise distillation rates, which are tabulated for all the rare-earth metals. (auth)

30339 ZONE-REFINING TUNGSTEN IN THE PRESENCE OF A SUPERIMPOSED DIRECT CURRENT. D. R. Hay and E. Scala (Cornell Univ., Ithaca, N. Y.). Trans. Met. Soc. AIME, 233: 1153-5(June 1965).

Electrotransport was superimposed on the rate-limiting step in zone refining which is the impurity diffusion through the liquid at the solid/liquid interface. The efficiency of zone refining is increased and relative resistivity ratios ($\rho_{300°K}/\rho_{4.2°K}$) can be increased by 50% in tungsten for a given number of passes using the electrotransport field-aided method. The effect of zone refining in the presence of an electric field on the relative resistivity ratio was examined as a function of its intensity and polarity. (auth)

30340 SORPTION OF CADMIUM FROM AQUEOUS-ORGANIC SOLUTIONS BY KU-2 CATION EXCHANGE RESIN AND SEPARATION OF RADIOACTIVE INDIUM AND CADMIUM. N. P. Rudenko, S. Vavra, and I. Duda (Research Inst. of Nuclear Physics, USSR). Vestn. Mosk. Univ., Ser. II, Khim., No. 1, 18-21(Jan.-Feb. 1965). (In Russian)

Sorption of cadmium from aqueous ethanol solutions by cationite KU-2 in hydrogen, ammonia, and 8-quinolinol showed that the highest sorption takes place in the ammonium form of KU-2 with any amount of ethanol and the lowest with 8-quinolinol. In the absence of ethanol the sorption of cadium with 8 oxyquinol was higher than with hydrogen. The cationite volume of cadmium in aqueous solutions for ammonium and hydrogen forms was found to be 3.30 to 3.20 mg·equiv/g KU-2. A complex ion exchange method was developed for separating radioactive cadmium and indium. The results of γ analysis of the initial irradiated cadmium solution measured in a 100 channel γ analyzer were plotted. The method of separation of radioactive indium from cadmium showed that aqueous-organic solutions of complexing reagents can be used in chromatographic separation procedures. (R.V.J.)

30341 A DEVICE FOR CONTINUOUS RADIOISOTOPE EXTRACTION. V. A. Muranov. Zavodsk. Lab., 31: 628 (1965). (In Russian)

Multiple extraction of radioisotopes by hot hydrochloric or nitric acid was accomplished with an automatic apparatus designed with continuous flow of acid over the specimen, which is placed in a capsule in the filter. (R.V.J.)

30342 ISOTOPE EXCHANGE INVESTIGATIONS ON SILICATE ION EXCHANGERS. II. USE OF THE ISOTOPE EXCHANGE METHOD TO INVESTIGATE FIXATION OF

VARIOUS IONS IN CLAY MINERALS BY HEATING. H. W. Levi and E. Schiewer (Hahn-Meitner-Institut für Kernforschung, Berlin). Z. Anorg. Allgem. Chem., 337: 105-12 (Apr. 1965). (In German)

The exchangeability of Na, Cs, Tl, Sr, and Ba ions in clays, particularly in bentonite and vermiculite, after heat treatment was investigated. Two groups of ions could be distinguished. Small ions were more and more fixed above 100°C with increasing treatment temperature. Larger ions were not fixed below 500 to 700°C but showed strongly increasing fixation at higher temperatures. In bentonite Sr^{2+} belonged to the small-ion group, in vermiculite it behaved as a large ion. The results are discussed with regard to the fixation mechanism as well as to the applicability of the ion exchange technique. (auth)

30343 PRODUCTION OF RARE EARTH CHLORIDE FROM BASTNASITE. Paul R. Kruesi and George Duker (Molybedenum Corp. of America, York, Penna.). 15p. (CONF-650203-7).

From National AIME Meeting, Chicago.

A method was developed for processing the bastnasite (rare earth fluorocarbonate ore) found at Mountain Pass, California. The process consists essentially of only three steps: attack, removal of fluoride, and neutralization. The ore concentrates as received were 65%−325 mesh. The concentrates were treated with HCl at 200°F for 4 hr. The reaction mass was decanted with the mother liquors going to storage and the solids receiving one water wash. The solids were treated with NaOH at 96°C to remove the fluoride. The rare earth hydroxides obtained in this step were mixed with the mother liquors of the preceeding step so that a final pH of about 3.0 was obtained. Impurities were precipitated by various methods. The resulting rare earth chloride solution was then concentrated by evaporation into either a concentrated solution or cast in solid form. A flowsheet is shown. Data are presented in tables and graphs. (M.C.G.)

30344 IMPROVEMENTS IN OR RELATING TO CENTRIFUGES AND TO METHODS OF SEPARATING IMMISCIBLE LIQUIDS. Derek Gordon Vallis and John Barry Laidler (to United Kingdom Atomic Energy Authority). British Patent 982,676. Feb. 10, 1965. Filed Dec. 8, 1960.

The centrifuge has a cup-shaped rotor with impermeable walls and a porous wall made of sintered glass mounted on the lip of the rotor. The porous wall with a pore size of 5 to 100 μ provides the sole outlet for liquid material under the influence of centrifugal force. The area of the porous wall is less than that of the impermeable walls. To separate two immiscible liquids with the centrifuge, the porous wall is precontacted with one of the liquids or with a liquid fully miscible with one of the liquids before the mixture is centrifuged. During the centrifugation, the rotor is rotated at such speeds that one of the liquids passes through the porous wall. (B.L.M.)

30345 METHOD OF SEPARATING PLUTONIUM AND URANIUM TOGETHER FROM AQUEOUS SOLUTION. Alfred Leonard Mills (to United Kingdom Atomic Energy Authority). British Patent 983,380. Feb. 17, 1965. Filed Feb. 20, 1963.

In the processing of mixed U and Pu fuels dissolved in aqueous nitric acid, the U and Pu values are extracted into an organic phase made up of TBP in an inert diluent. The organic phase is then backwashed with a sulfuric acid solution of such concentration and in such volumes that the ratio of moles of Pu in the organic phase to moles of acid in the aqueous phase is between 1.5 and 2.5, preferably 2.0. (B.L.M.)

30346 METHOD AND DEVICE FOR THE REFINING OF IRRADIATED URANIUM. Jean Erler, Robert Peray, and Jean Petit (to Commissariat a l'Energie Atomique). German Patent 1,182,837. Dec. 3, 1964. Priority date Mar. 18, 1961, France.

The molten contaminated metal is contacted with oxide-containing cinders, which have a lower melting point than the uranium. The uranium is melted below the surface of the cinder, which is composed of an eutectic mixture of beryllium oxide and at least one of the oxides of barium, calcium, strontium, magnesium, lithium, and lanthanum. The system is cooled down to a temperature between the melting points of the cinder and the uranium, and the solid refined uranium is separated from the fluid cinder. An arc furnace for carrying out this method is described. (Gmelin Inst.)

30347 RECOVERY OF RHODIUM FROM FISSION PRODUCTS. Eugene A. Hausman (to Engelhard Industries, Inc.). U. S. Patent 3,166,404. Jan. 19, 1965. Filed Mar. 4, 1959.

A process is reported for the recovery of rhodium from fission products by treating an acid solution containing rhodium to precipitate the sulfides. The redissolved sulfide is converted to a base-soluble complex rhodium salt by adjusting the pH of the solution to the basic range (about pH 10), and the base metal hydroxides are precipitated. The rhodium is separated from the solution and recovered as rhodium metal by a suitable reduction process. Ruthenium tetroxide may be removed from the solution of fission products containing rhodium prior to precipitation of the rhodium sulfide. (B.L.M.)

30348 ION EXCHANGE PROCESS FOR SEPARATING THE RARE EARTHS. Mark M. Woyski (to American Potash and Chemical Corp.). U. S. Patent 3,167,389. Jan. 26, 1965. Filed May 15, 1962.

A method is described for the separation of rare earths and yttrium from mixture of these by an ion exchange process that permits the recovery and reuse of the sequestering agent. Several columns filled with a resin such as Amberlite IR-120 are operatively interconnected and arranged for selective isolation. At least one of the columns serves as a separation zone and is loaded with quantities of a solution containing a mixture of the ions to be separated. The next successive columns are established as a retainer zone by loading the resin with quantities of a solution containing a mixture of rare earth and yttrium ions that serve as a retainer. The retainer ions have an effective atomic number at least as high as the effective atomic number of the ions in the mixture to be separated. An aqueous solution of the ammonium salt of ethylenediamine-tetraacetic acid in solution having a pH range from 2.5 to 4.5 is used as an eluting solution sequestering agent. After exchange between the eluting solution and the ions loaded on the resin in the separation zone, the modified eluting solution exchanges with the retainer ions. Treatment of the liquid effluent from the retainer zone with mineral acid separates the sequestering agent from the retainer ions. After the separated sequestering agent is passed through an ion-exchange liquid-medium preparation zone, it can be recycled to the first stage of the process. The retainer ions are also available for reuse. (B.L.M.)

30349 METHOD FOR PURIFYING RADIOACTIVE WASTE LIQUID. Walter L. Hayden, Jr., and Frank J. Dzierzanowski (to Minerals and Chemicals Philipp Corp.). U. S. Patent 3,167,504. Jan. 26, 1965. Filed Oct. 4, 1961.

A method is described for purifying an aqueous waste liquid containing a low level of radiocesium in the form of a dissolved salt of a mineral acid by absorbing the cesium with a synthetically produced zeolite. The zeolite containing 4 to 14 moles of SiO_2 and from 1 to 2 moles of Al_2O_3 per mole of Na_2O was obtained by precipitating oxides of Na, Al, and Si in intimate association with finely divided particles of pre-precipitated SiO_2. The contacting of the aqueous waste liquid with the zeolite was carried out at ambient temperatures for a time ranging from about ½ to 48 hr. (B.L.M.)

ENGINEERING

General

30350 THERMAL STRESS ANALYSIS OF CONICAL SHELLS. F. J. Witt (Oak Ridge National Lab., Tenn.). Nucl. Struct. Eng., 1: 449-56 (May-June 1965). (ORNL-P-1243)

The differential equation of a conical shell subjected to axisymmetrical temperature distributions was derived. The temperature distributions may vary in the meridional direction and linearly through the thickness. In order to obtain a particular solution to the differential equation, the expression for the temperature distributions is assumed to be the sum of hyperbolic and cubic functions. The particular solution is superposed on the homogeneous solution and all the formulas for a complete analysis are given. (auth)

Facilities and Equipment

Refer also to abstracts 30064 and 30618.

30351 (CERN-65-10) DISTORTION OF FAST PULSES IN COAXIAL CABLES. NUMERICAL ANALYSIS AND APPLICATIONS. G. Brianti (European Organization for Nuclear Research, Geneva (Switzerland)). May 3, 1965. 29p. Dep.(mn).

A mathematically simple theory for the response of matched coaxial cables to "fast" pulses, i.e., pulses for which the lower frequencies of the spectrum are on the order of 0.1 Mc, is presented. From this theory is derived a numerical method for analyzing the response and distortion characteristics of the cable. The numerical method is suitable for hand or computer calculation, and is capable of accepting any input function. (T.F.H.)

30352 (TID-4100(Suppl.27)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Richard E. C. Duthie, ed. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Apr. 1965. 76p. Dep.; Free (DTI Extension).

Included are lists under engineering equipment (miscellaneous), hot laboratory equipment, hot laboratory structures, instruments, metallurgical equipment and processes, nuclear radiation instruments, reactors and reactor facilities, particle accelerators, plant design and processes, radiation source units, and waste disposal equipment. (D.L.C.)

30353 DEVELOPMENT AND PRESENT-DAY ASPECTS OF HOT LABORATORIES. II. THOUGHTS ON SOME RECENT DEVELOPMENTS. G. Cherel. Energie Nucl., 7: 83-92 (Mar.-Apr. 1965). (In French)

Hot laboratories, which have many functions, have a certain number of essential characteristics in common, based principally on the necessity to protect the operators against radioactivity and on the rigorous working conditions that the manipulated materials require. The problems encountered by the builder in the construction of hot laboratories are explained. Some recent work and various types of apparatus designed or adapted for work in cell are described. A sketch is given of the role that could be assigned to an engineering company in the design of this sort of installation. (auth)

30354 AIRBORNE SCAN CONVERTER SYSTEM (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Livermore). 16 drawings. (CAPE-1251)

Very high bandwidth, single-transient information in a rocket-borne experiment is converted to a much lower bandwidth using this system. Application of the scan converter technique to single-transient information of nanosecond rise time permits conversion to bandwidths commensurate with present day telemetry systems. Single storage rise time capability is 1–10 nsec depending on the type of storage tube used. The delay in the transistorized linear sweep between the trigger and the start of the sweep is less than 6 nsec and the sweep voltage is ±400v. Other transistorized circuitry used includes a readout sweep, time base generator, and a signal amplifier. Drawings (16) are included. (CFSTI)

30355 TYPEWRITER, MARK 2 (Engineering Materials). (Los Alamos Scientific Lab., Univ. of California, N. Mex.). 6 drawings. (CAPE-1000)

Formerly the Flexowriter (Japanese), this typewriter is similar to the Friden Flexowriter. It has the ability to automatically index the platen by a half line at a time in up and down directions, and to display mathematical formulas in the preparation of input paper tapes for the MANIAC computer. Added components accommodate super- and subscripting. The ribbon color may be positively selected. Drawings (6) are included. (P.C.H.)

30356 TUNGSTEN FURNACE, 5000°F (Engineering Materials). (Southern Research Inst., Birmingham, Ala.). 11 drawings, 4 photos. (CAPE-1191)

The radiant heating furnace provides a carbon-free environment through temperatures that range above 5000°F in a Stress-Strain Facility. The compact, reliable source has a Cu furnace shell 8 in. ID, 8½ in. OD, and 15 in. long. Zirconium insulators are used and tungsten spirals 3/16 in. wide × 0.001 in. thick are used to fill the annulus. A split Cu electrode is employed. End plates are Cu discs 8⅝ in. in dia. and ½ in. thick. The furnace shell is water-cooled by tracing the shell with ¼ in. Cu tubing. (For Details, See TID-4100) (P.C.H.)

30357 GRAPHITE FURNACE, 6500°F (Engineering Materials). (Southern Research Inst., Birmingham, Ala.). 7 drawings, 3 photos. (CAPE-1192)

The 6500°F furnace is used in a facility that determines the true stress-strain properties of brittle materials at very high temperatures. The furnace equipment provides radiant heating in the elevated temperature range to evaluate the effects of pressure on the sublimation rate of graphite elements and to allow a close examination of power requirements, thermal properties, and pressure control. The furnace heating element of stepped diameter tubular graphite is insulated from the water-cooled pressure shell by thermatomic carbon. The hot zone, which is 2 in. long and 1½ in. in dia., is contained by thermatomic carbon around the periphery of the element and by heat shields of pyrolytic graphite inside the element. A sight port, which provides visual access to the hot zone, employs pyrolytic graphite as the heat dam. Although the design pressure is 750 psi, the furnace has been tested at 950 psi. (For Details, See TID-4100) (P.C.H.)

30358 PIPETTERS (Engineering Materials). (Oak Ridge National Lab., Tenn.). 17 drawings. (CAPE-1120)

Servo-controlled, remotely operated pipetters used to handle intensely radioactive liquids that may be extremely corrosive are described. They operate reliably with a precision of 0.2% (relative standard deviation of 14 deliveries) for aliquots equal to one-tenth nominal volume. Actual delivery volume of the 1 ml pipetter is 0.8 ml and 2.4 ml for the 3 ml pipetter. Solutions containing sulfuric, nitric, and hydrofluoric acids can be tolerated. (For Details, See TID-4100) (M.C.G.)

30359 VIBRATION DAMPING MOUNT (Engineering Materials). (Bendix Corp., Kansas City, Mo.). 6 drawings. (CAPE-1201)

The device limits vibration amplification by the method of force limiting. It consists of a spring and a two part surrounding housing which is arranged so that sliding friction between the two housing parts occurs when the device is loaded with sufficient force to reduce its overall height. The device acts as a spring with hysteresis characteristics. The damping mount removes kinetic energy from the package as it goes into a resonance condition. By limiting the

acceleration forces between the package and the support structure, the vibration of the package is limited or prevented from building beyond a predetermined maximum value. (For Details, See TID-4100) (P.C.H.)

30360 DECAPPERS (Engineering Materials). (Oak Ridge National Lab., Tenn.). 5 drawings, 3 photographs. (CAPE-1221)

Decappers, with self-energizing clamps, which open and close glass bottles with plastic screw caps by remote control are described. A bottle is placed in a clamp having a pair of opposing rubber-faced jaws so disposed that any tendency of the bottle to turn in the clamp causes an increase in the force holding it in place. A similar, nonrotating clamp holds the bottle cap. The bottle clamp is driven by a reversible motor. (For Details, See TID-4100) (M.C.G.)

30361 IMPROVEMENTS RELATING TO VESSELS. (to Atomic Energy of Canada Ltd.). British Patent 979,603. Jan. 6, 1965. Priority date Jan. 11, 1962, United States.

A dump port construction is provided that will increase the velocity of liquid flow while all other factors remain substantially equal so that the total mass flow for a given size port can be increased. The port is adapted for use at the bottom of a vessel for confining a free surface of a liquid to enable a body of the liquid to be supported in the vessel by gaseous pressure on the free surface and for allowing rapid outflow of the liquid upon release of the pressure. The port includes a passage extending from upstream to downstream made up of three straight portions that discharge into U-bends. The inner surfaces of the passage at the U-bends are formed by smoothly curved surfaces of substantial radius. The passage is convergent in the downstream direction at both U-bends, and the second straight portion is divergent in the downstream direction. (B.L.M.)

30362 IMPROVEMENTS IN OR RELATING TO CONVEYOR SYSTEMS FOR PACKAGE IRRADIATION PLANTS. Sidney Jefferson (to United Kingdom Atomic Energy Authority). British Patent 982,424. Feb. 3, 1965. Filed Nov. 26, 1962.

A conveyer system for package handling in an irradiation facility includes an open-end elongated tubular carrier, moveable on an overhead railway. Openable and closeable package retaining means are provided at the bottom of the carrier. A section of the railway can be moved in such a way that a carrier is tipped into a horizontal position for package loading and into a vertical position for transit. Preferably, a section of the railway is attached to a frame pivotable about a fixed fulcrum in such a way that a carrier on the rail section may be tipped together with the railway section and frame. (B.L.M.)

30363 MEANS FOR MEASURING THE RADIO-ACTIVITY OF AEROSOLS. (to Landis and Gyr AG). British Patent 982,699. Feb. 10, 1965. Priority date Oct. 24, 1961, Switzerland.

A filter strip conveying means for a plant adapted to measure the radioactivity of aerosols includes an endless flexible and perforated conveyor belt supported on two spaced apart guide drums with a motor arranged to drive through a gear one of the two guide drums. The driven guide drum is provided with teeth that can engage the perforations provided in the belt. A filter strip supply roll is adapted to contact the belt in the region of one of the guide drums and extends to a take-up roll adapted to contact the belt in the region of the other guide drum. The filter strip is supported on the belt in the region between the two rolls, and both rolls bear with pressure on the belt. (B.L.M.)

30364 IMPROVEMENTS APPLIED TO MEANS FOR CONTINUOUSLY SORTING RADIOACTIVE ELEMENTS. Andre Laforet (to Commissariat a l'Energie Atomique). British Patent 982,763. [Feb.] 10, 1965. Priority date Oct. 24, 1960, France.

An apparatus is provided for sorting lumps of radioactive material conveyed at substantially constant intervals on a conveyor belt driven at a constant speed. The apparatus includes a radioactivity detector disposed to detect radioactivity in a predetermined zone including part of the path of the conveyor. The detector emits pulses that have a repetition function that is an increasing function of the activity detected. An integrator accumulates the pulses, and when the total of accumulated pulses reaches a predetermined number, the integrator produces a threshold signal that is stored in a memory unit. An indicating device situated at the edge of the zone is adapted to produce an exit signal indicating the exit of a lump from the zone. When the memory unit receives both a threshold and exit signal that has been fed from the indicating device to the memory, a signal is sent from the memory to the ejector device. A delay circuit is provided between the memory and the ejector device to delay the signal from the memory unit by an amount of time equal to the time taken for the lump to pass from the indicating device to the ejector. (B.L.M.)

30365 SHIELDING WALL LEAD-THROUGH FOR MANIPULATORS. Hans Waelischmiller. German Patent 1,182,759. Dec. 3, 1964. Filed May 25, 1962.

The lead-through consist of a tubular outer housing secured in the shielding wall, a central rotable housing or drive shaft passing through the outer housing, and an intermediate housing located concentrically between them. The intermediate housing is sealed by two "O" rings disposed between the outer and the intermediate housing, and by two seals of the lip type with a U-profile disposed between the central and intermediate housing opposite to the "O" rings. The space between the "O" rings communicates via openings in the intermediate housing with the space between the seals of the lip type. The cavity between these four seals is connected to an oil feed line, which terminates at a vertical glass tube thus enabling a faulty seal to be detected by observation of the oil level. (Gmelin Inst.)

30366 DIAPHRAGM PUMPS. Donald Matthias Somerville Greenhalgh and Robert Jeremy Sherwood (to United Kingdom Atomic Energy Authority). U. S. Patent 3,166,239. Jan. 19, 1965. Filed June 12, 1961.

A diaphragm pump is provided that can be powered by portable batteries and is suitable for use in a personal air sampler. The pump includes a pump head with inlet and outlet ports each with a flap valve, a diaphragm having a central aperture, and means for clamping the perimeter of the diaphragm to the pump head. An attachment member is located in the central aperture and includes parts spaced apart to engage the opposed surfaces of the diaphragm adjacent to the aperture. The spacing between the parts is greater than the thickness of the diaphragm. A driver is connected to the attachment member to extend normal to the plane of the diaphragm, and means are provided to impart reciprocation to the driver to flex the diaphragm. A 6-volt constant-speed motor running at about 1700 rpm from mercury type batteries powers the pump. If the pump is used in an air sampler, a sampling head is connected to the inlet port by a length of flexible tubing. (B.L.M.)

Heat Transfer and Fluid Flow

See also PHYSICS — General.

Refer also to abstracts 30068, 30653, and 31463.

30367 (AE-178) AN ANALYTICAL AND EXPERIMENTAL STUDY OF BURNOUT CONDITIONS IN VERTICAL ROUND DUCTS. Kurt M. Becker (Aktiebolaget Atomenergi, Stockholm (Sweden)). Mar. 1965. 161p. Dep.(mn).

An analysis for predicting the burnout conditions for flow of boiling water in vertical round ducts is presented. The analysis which is based on the Vanderwater flow model predicts that the burnout conditions are independent of the inlet subcooling and the heated length, and depends only on the local values at the burnout position of pressure, heat

flux, steam quality and mass velocity and duct diameter. The results of an experimental investigation covering 811 burnout measurements in the pressure range from 41 to 101 kg/cm^2 is presented. These results together with 488 earlier burnout measurements at the pressures of 2.7, 10, 20, and 30 kg/cm^2 were used to determine two constants in the analytical results. The final correlation predicted the burnout heat fluxes of the 1299 measurements within ±8 per cent and with an rms error of 5.3 per cent. The measurements covered the following ranges of variables: diameter, 3.93–24.95 mm; heated length, 400–3500 mm; L/d-ratio, 40–890; pressure, 2.7–101 kg/cm^2; inlet subcooling, 30–240°C; mass velocity, 120–5450 kg/m^2 sec; heat flux, 35–686 w/cm^2; and burnout steam quality 0–1.00. The Columbia data and the Winfrith data are also analyzed in terms of the measured and predicted burnout heat fluxes and enthalpies, and it was found that a very good agreement existed between the present results and the Columbia and the Winfrith data. The Columbia data were on the average 3 per cent lower, comparing the measured and predicted burnout heat fluxes. The scatter of the data was within +10 and –15 per cent and the rms error was 8.4 per cent. The Winfrith data were on the average 6 per cent higher, than the predicted heat fluxes and the deviations of the measured heat fluxes were within +25 and –15 per cent of the predictions. The rms error was 10.8 per cent. (auth)

30368 (AGN-8127) ALKALI METALS EVALUATION PROGRAM. SWIRL FLOW BOILING OF ALKALI METALS HEAT TRANSFER AND PRESSURE DROP. C. R. Fisher, J. H. Moskowitz, and L. T. Clark (Aerojet-General Nucleonics, San Ramon, Calif.). Jan. 1965. Contract AT(04-3)-368. 103p. Dep.(mn); $4.00(cy), 3(mn) CFSTI.

Investigations were made of the heat transfer and pressure drop characteristics of rubidium, cesium, and potassium boiling in a round tube in which a twisted metal ribbon was inserted to promote swirl flow. The experiments were performed in a niobium–1% zirconium alloy loop operated in an argon atmosphere at temperatures to 1850°F. Operating parameters were varied to obtain information useful to designers of boilers for space power systems. Stable pressure and flow conditions were achieved for most of the test runs. Data on nucleate boiling, liquid heating, and critical, or burnout, heat transfer are tabulated. A fog flow model is used to predict the critical heat flux, and reasonable agreement with the data is obtained. Pressure drop data are tabulated. A homogeneous flow correlation is found to give satisfactory agreement with the data. A comparison of the swirl flow data and axial flow results is presented. An appendix provides useful data on thermophysical properties of the fluids studied. (auth)

30369 (APPE-24) MEASUREMENT TECHNIQUES IN TWO-PHASE FLOW. G. A. Wikhammer, E. O. Moeck, and I. P. L. Macdonald (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Oct. 1964. 48p. (CONF-640916-1; AECL-2215). Dep.; $1.00(AECL).

From Conference on Research for and in Industry, Ottawa.

The application of two measurement techniques to the study of two-phase, gas/liquid flow phenomena is described. The first technique relies on an imbedded thermocouple to detect the incipient critical heat flux as well as the surface temperature of an electrically heated rod, forced-circulation cooled by a steam/water mixture at 1000 psia. The heater-thermocouple assembly is calibrated in situ. The overall temperature difference between the thermocouple plane in the heater wall and the bulk coolant is measured when cooling by water and then superheated steam. The Colburn relationship is used to obtain the film temperature drop. By difference, the effective wall thermal resistance is obtained. In the second technique, small electrodes imbedded in an insulating wall are utilized to measure the thickness of a thin, conducting water film on the surfaces of a complex flow channel. Air/water mixtures at room temperature and pressure below 100 psia are circulated through the test channel. An electronic network produces 2 microsecond voltage pulses, proportional to the film thickness, and suitable for spectrum analysis. A pulse-stretch-and-hold unit shapes the pulses such that high speed paper recorders, coincidence counters, analog tape units, and other correlators can be utilized. (auth)

30370 (BNL-8186) HEAT TRANSFER IN PARALLEL-PLATE CHANNEL WITH PERIODIC BOUNDARY CONDITIONS. Chia-Jung Hsu (Brookhaven National Lab., Upton, N. Y.). May 18. 1964. Contract AT(30-2)-Gen-16. 17p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The problem of heat transfer to fluids flowing inside channels with wall temperature or wall heat flux varying in a periodic manner is analyzed. The behavior of Nusselt numbers in such a periodic heat transfer process is studied with the assumption of slug flow between parallel plates. (D.L.C.)

30371 (GEAP-4721) MULTIROD (TWO-ROD) TRANSITION AND FILM BOILING IN FORCED CONVECTION TO WATER AT 1000 psia. J. E. Hench (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Oct. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT (04-3)-189. 31p. (EURAEC-1262). Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Multirod (two-rod) data are presented which show the effect of a roughened channel (wall trippers), ceramic fuel pellets, downflow, rod-to-rod spacing, and presence of adjacent rods on critical heat flux, transition, and film boiling. The data are obtained with a two-rod test section at 1000 psia pressure and mass velocities of 1.0, 1.4, and 2.0M lb/hr-ft^2. The heater rods are $^7/_{16}$-inch OD tubes, 30 inches long. (auth)

30372 (HW-SA-3632) GRAPHICAL SOLUTION FOR BRANCHING PIPE FLOWS. Claud C. Lomax (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). [June 27, 1964]. Contract AT(45-1)-1350. 25p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A graphical procedure leading to a direct solution of flow distributions and pressure losses in complex branching pipes is presented. An example is given in which both inputs to the system and draws from the system vary with the pressure. (auth)

30373 (NAA-SR-Memo-9524) NAA PROGRAM DESCRIPTION — TURBO-PUMP CODE. Hessler, J. A. (Atomics International, Canoga Park, Calif.). Feb. 1964. Contract AT-11-1-GEN-8. 40p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The main objective of this program was to obtain, for a given pressure ratio, design speed, number of stages, flow rate, and temperature into a pump, the overall efficiency and power required, and the hydraulic diameter of each stage. The program uses steam tables obtained from Westinghouse for property data. Therefore the program is restricted to simulation of the pumping of water. (auth)

30374 (NAA-SR-Memo-9791) NAA PROGRAM DESCRIPTION. 30-THGC — A 30-NODE TRANSIENT OR STEADY-STATE HEAT GENERATION CODE. Blaine, R. A. (Atomics International, Canoga Park, Calif.). Apr. 1964. Contract AT-11-1-GEN-8. 31p. Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

30-THGC is a generalized transient or steady state one, two, or three-dimensional Heat Generation Code, an outgrowth of THGC, designed to provide maximum flexibility and simplicity to the engineer. Although designed explicitly for conduction and radiation, other modes of heat transfer can be included by appropriate definition or conduction coefficients. Use of FAP (machine language) programming in conjunction with Fortran has greatly reduced running time over that required by THGC. Other new features are the treatment of steady state problems by the Aitken Delta Squared Method, redefinition of the coefficients, provision for multiple ramps, and a convergence criterion. (auth)

30375 (NAA-SR-Memo-10992) NAA PROGRAM DESCRIPTION. SUPERCRITICAL STEAM GENERATOR. Chang, Gwendolynne T. (Atomics International, Canoga Park, Calif.). Feb. 1965. Contract AT-11-1-GEN-8. 31p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A description is given of an iterative calculation to determine a steady state temperature distribution for a Supercritical Steam Generator. This routine consists of a main program and two subroutines. (auth)

30376 (NASA-TN-D-2860) EXTENSION OF AN ANALYSIS OF PERIPHERAL WALL CONDUCTION EFFECTS FOR LAMINAR FORCED CONVECTION IN THIN-WALLED RECTANGULAR CHANNELS. Joseph M. Savino and Robert Siegel (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). June 1965. 33p. $2.00(CFSTI).

An earlier analysis was extended to include two cases of greater generality. The first case was a rectangular duct of arbitrary aspect ratio with uniform heat generation and heat conduction within the broad walls as in the previous analysis. The extension made is to allow the short walls to also be heat conducting, but with the restriction that a junction of infinite thermal resistance exists between the broad and short sides so that heat flow around the corners cannot occur within the walls. The temperatures within the duct were governed by a Poisson equation, with the normal derivatives at the boundaries expressed in terms of the second partial derivatives along the boundary to account for the conduction within the walls. An analytical solution was obtained for the temperatures in the fluid and on the boundaries by using a product solution in the form of a Fourier series expansion. The unknown wall temperatures were contained in the integrals required for the Fourier coefficients so that the wall temperatures were expressed by an integral equation. An analytical solution was found, and results were evaluated numerically on a digital computer. The peripheral conduction within the side walls produced the following effects: (1) The temperature distribution along the unheated side walls became quite uniform for even small values of wall conductivity. (2) For aspect ratios less than 5, the temperatures of the heated broad walls were lowered by a significant amount; for aspect ratios greater than 5, only small temperature decreases occurred on the broad walls for a very narrow region adjacent to the corner. The second case studied was a square duct with uniform heating and peripheral heat conduction in all walls. The solutions provided quantitative information on how the wall temperatures become more uniform as a function of wall conductivity. For large wall conductivity, the results were in agreement with the uniform peripheral wall temperature solution. (auth)

30377 (ORNL-TM-1101) CENTRIFUGAL FLOWMETER TESTS. W. R. Gambill (Oak Ridge National Lab., Tenn.). Apr. 20, 1965. Contract W-7405-eng-26. 22p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Calibration tests were made with two centrifugal flowmeters, fabricated by bending tubing into a 360-deg circle, by measuring the pressure differential between the inside and outside of the curved flow path between the ends of a tube diameter and relating it to the flow rate. It was found that the form of a proposed flow rate equation is correct, but that specific meters should be individually calibrated for accurate absolute results. Measurements of pressure loss between the inlet and outlet of a meter gave curved-section friction factors about a third larger than those previously reported for hydraulically smooth curved pipes. The total pressure drop across the meter tested was ~27% larger than that across an equal length of equally rough straight tubing. This type of meter appears to offer no clear-cut advantages beyond its simplicity. (auth)

30378 (SR-4-5) TASK R QUARTERLY PROGRESS REPORT NO. 21 FOR THE PERIOD APRIL 1–JUNE 30, 1964. (Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.). Contract NOw 62-0604-c. (AD-602084)

Results from a large number of runs to measure the $O\text{-}O_2$ diffusion coefficient in flow tubes are discussed. The general behavior is represented by nonlinear plots of log $(O)/(O)_0$ vs distance, indicating an overall loss of O-atoms which is not first order. A comparison of relative O atom concentrations determined by ESR signal peak heights and by monitoring the O-NO glow with a photomultiplier is given. Experiments with aerodynamic beams of He-Ar mixtures in the prototype apparatus are described. A final design for the crossed beam apparatus is given and the various specifications of the beams are estimated. Design criteria for aerodynamic beams are outlined. Recent experience with the high temperature CO_2 calibration equipment for the fast scanning infrared spectrometer is described. Reproducibility of the technique was demonstrated by repeating an earlier rocket tunnel test run. The CO_2 absorption at 4.24μ at the 1.35 in. station was within 0.1% of the previous value. (J.R.D.)

30379 (UCRL-14227-T) CONTACT RESISTANCE BETWEEN METALS DURING TRANSIENT HEATING (thesis). Dale Albert Schauer (California Univ., Berkeley). 1963. Contract W-7405-eng-48. 59p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

An experimental method for determining the conductance at the interface between two metal slabs during transient heat transfer is described. The technique employed was to heat rapidly one slab and then allow the two to come to equilibrium. Results were obtained for an aluminum-stainless steel contact varying the surface finish from 5-50 μin. AA (Al), 5-38 μin. AA (S.S.), and the pressure range 100-2000 psi. The average joint temperature was 150°F, with air in the voids. The temperature pulse was obtained by discharging a low-inductance capacitor bank (0.1 μH, 50,000 joules) through the plates. The resultant heating of each metal slab is inversely proportional to its resistivity. Each plate was instrumented with a 0.001 inch diameter chromel-constantan thermocouple spot-welded in a shallow groove (0.003 inch by 0.010 inch). The groove was then filled with silver-powder epoxy which after curing is finished flush with the surface. These thermocouples provided records of the surface temperatures at the interface and thus the temperature drop across the interface. Constant pressure was applied with a hydraulic jack. The surface temperature records were utilized in a Duhamel integral to obtain the heat flux. Over the period of temperature measurement (36 milliseconds), the conductance in individual tests was found to remain approximately constant or gradually increase about 10%. Average values of the interface conductance over the first 20 milliseconds of heat transfer varied from 460-3700 Btu/hr-ft^2°F at 100 psi to 2100-8300 Btu/hr-ft^2°F at 2000 psi. These results compare favorably with those of previous steady-state investigations, both experimental and analytical. (auth)

30380 (ANL-Trans-171) STATISTICAL ANALYSIS OF THE LOCAL STRUCTURE OF A TWO-PHASE FLOW. I. DESCRIPTION OF THE OCCURRENCE OF BUBBLES. C. Lackme (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Translated by M. Patricia Sughroe (Argonne National Lab., Ill.), from Note TT No. 162, 1-10(Feb. 1964). 19p. Dep.(mn); $1.60 (fs), $0.80(mf) JCL.

It can be shown that the occurrence of the bubbles at a point is random. From a summarized theoretical consideration, the Galton-MacAllister distribution hypothesis is suggested concerning the time intervals between the passage of the bubbles. A χ^2 test confirms the validity of this hypothesis. The distributions as obtained by varying the total gas-flow indicates that their law depends on one parameter only. From the form of the standard deviation obtained a second order Erlang distribution may be assumed; the result of a χ^2 test also makes one accept this second hypothesis. The normal log distribution is convenient for a graphic study, while the Erlang distribution is more convenient in theoretical developments. (auth)

30381 (ANL-Trans-172) STATISTICAL ANALYSIS OF THE LOCAL STRUCTURE OF TWO-PHASE FLOW. II. CHANGE OF CONFIGURATION AND DISTRIBUTION WITH THE OCCURRENCE OF BUBBLES. C. Lackme (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Translated by M. Patricia Sughroe (Argonne National Lab., Ill.), from Note TT No. 176, 1-18 (Oct. 1964). 23p. Dep.(mn); $2.60(fs), $0.89(mf) JCL.

Both the air flow, G, and water flow, L, were varied systematically. It is shown that the Erlang distribution fac-

tor, k, for the occurrence of bubbles at a point in the channel is characteristic of the flow structure. When k = 1, it corresponds to individual bubbles in the liquid; when k = ∞, it corresponds to slug flow whose periodicity has been noticed by many other authors. Between these two extremes, the value k = 2 is observed for a relatively long time during the transition which precedes the appearance of the slug flow and extends through a small region of the flow. The study of the average time interval between bubbles shows that they tend to be expelled from the axis of the channel when the water flow increases at constant air flow. The description of the variation of the distance between bubbles, d, as a function of flow L and G results in the axis of the channel of relaxation of the form: $d = (f(L)/G^{\frac{1}{3}})$. (auth)

30382 (UCRL-Trans-1219(L)) DESIGN AND CONSTRUCTION OF A CORRECTOR SYSTEM FOR THE RESIDUAL ABERRATIONS IN A SPHERICAL MIRROR OF VERY LARGE APERTURE. J. Pouleau. Translated by W. G. Robinson (Lawrence Radiation Lab., Univ. of California, Livermore), from Rev. Opt., 37: 577-97(1958). 43p. Dep.(mn); $4.60(fs), $1.49(mf) JCL.

Various wide-aperture optical devices incorporating spherical concave mirrors and correcting elements are studied. A system based on the Schmidt plate principle is discussed and compared to objectives of known types, the system being considered both from the point of view of correction performance and of simplicity of manufacture. Correction of mirror spherical aberration is obtained by using a set of two complementary aspherical plates cemented together, the refractive indexes being somewhat different. The major merit of the system is, as calculation shows, that plate cutting accuracy requirements depend only upon the difference between the respective indexes of the two plates. Assuming a difference in the order of $5 \cdot 10^{-4}$, the accuracy requirement of approximately 0.03 mm, a degree of precision that can be easily achieved by purely mechanical means, without final correction. With Schmidt plates of conventional type, the accuracy requirement would have been 0.2 μ. Another advantage of this system is that achromatic plates can be obtained by using materials of identical or near-identical dispersion values for the two plates. (auth)

30383 (WAPD-Trans-17) CRITICAL HEAT FLUXES IN ANNULAR CHANNELS WITH HEAT SUPPLY FROM TWO SIDES. G. V. Alekseev (Alekseyev), B. A. Zenkevich, and V. I. Subbotin. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from Inzh.-Fiz. Zh. Akad, Nauk Belorussk. SSR, 7: No. 9, 30-3(1964). 5p. Dep.(mn); $1.00(cy), 1(mn) CFSTI; $1.10(fs), $0.80(mf) JCL.

Results are given covering the experimental investigation of critical heat fluxes in an annular channel with a two-way heat supply for a forced flow of water underheated to saturation temperature and a steam–water mixture. (auth)

30384 ACOUSTICAL PROPAGATION OF THERMALLY INDUCED STRESSES. Measures, R. M. (Imperial Coll. of Science and Tech., London). Acustica, 15: 133-8(1965).

The pressure in a hot plasma ($T \sim 40{,}000°K$) formed by a pulsed electrical discharge, was measured with a piezoelectric transducer sandwiched into an acoustical delay line of fused quartz. The problem of thermally induced stresses, which might affect such measurement, was analyzed for the case of such a probe. It is shown that a compressive stress, determined principally by the factor $(\alpha\sqrt{K/S})(Q_{max}/\sqrt{T_0})$ propagates away from the heated region with an acoustical velocity. α is the coefficient of linear expansion, K the thermal diffusivity, and S the specific heat of the delay line. Q_{max} is the maximum value of the incident heat flux, and T_0 is the time for the heat flux to maximize. This effect, which has not been previously considered, imposes a limit on the design of pressure probes. (auth)

30385 NUMERICAL SOLUTION OF MAGNETOHYDRODYNAMIC STAGNATION-POINT FLOW EQUATIONS. R. J. Gribben (Univ. of Southampton, Eng.). AIAA (Am. Inst. Aeron. Astronaut.) J., 3: 972-3(May 1965).

A method for solution by successive approximations of a coupled system of equations for flow of a conducting fluid near a stagnation point is described. (D.C.W.)

30386 A DILATATION TECHNIQUE FOR MEASURING TOTAL STEAM VOLUME IN A HEATED CHANNEL IN OPEN-LOOP OPERATION. J. B. van Erp and G. Possa (EURATOM, Brussels and Laboratori CISE, Milan). Energia Nucl. (Milan), 12: 301-5(June 1965).

A new method for measuring total steam volume in heated channels, cooled by vaporizing water in forced circulation, is outlined as an extended version of the dilation technique in closed-loop operation, with which it shares the advantages of simplicity and applicability to complicated geometries, and over which it has the additional advantage of absence of enthalpy feedbacks to the inlet conditions. (auth)

30387 AN EXISTENCE PRINCIPLE FOR STATIONARY CURRENTS IN MAGNETOHYDRODYNAMICS. J. Foerste (Institut fur Angewandte Mathematik und Mechanik, Deutsche Akademie der Wissenschaften, Berlin). Monatsber. Deut. Akad. Wiss. Berlin, 6: 886-94(1964). (In German)

The principle for the existence of stationary currents is derived as an internal spatial boundary value problem of the stationary MHD basic equations for an incompressible viscous liquid. A proof of the principle is given. (J.S.R.)

30388 TUBULAR HEAT EXCHANGER ELEMENT. Eric Maurice Woolley and Cecil Rounthwaite (to Head, Wrightson and Co. Ltd.). British Patent 980,412. Jan. 13, 1965. Filed July 24, 1961.

A tubular heat exchanger element includes means for making the inside temperature coefficient approximately balance the outside coefficient. The element includes a tube with a series of circumferentially spaced spines or ribs formed on its inner surface and one or more helical guide plates arranged within the tube. The plates extend lengthwise of the element in such a manner as to restrict the direct flow path through the element and to cause the fluid passing through the tube to circulate in directions that are substantially transverse to the axis of the tube. The guide plate(s) form part of a central core that can be inserted into the tube. The core consists of the guide plates and a central support to which they are attached. (B.L.M.)

30389 MULTI-PRESSURE BOILER CONSTRUCTION. Eric Maurice Woolley and Cecil Rounthwaite (Head, Wrightson and Co. Ltd.). British Patent 980,413. Jan. 13, 1965. Filed July 24, 1961.

A multi-pressure boiler is provided that achieves a simpler and more compact design of boiler for generating steam at more than one pressure. The tubes in any one steam circuit are arranged to have equal heat loads, and the loads can be arranged to be the exact required values. The usual complicated baffling on the gas side to avoid leakages is avoided. The vertical tube type boiler for the evaporator gives unobstructed flow to bubbles generated in the tubes and promotes steady steaming and flow conditions. A restrictor provided in the economizer section serves to promote flow stability as well as to increase heat transfer. True contra-flow conditions of operation result in a saving in outer surface area as compared with known cross-flow designs of boilers. (B.L.M.)

30390 IMPROVEMENTS IN AND RELATING TO CALORIMETRIC MASS FLOW METERS. (to Reactor Certrum Nederland). British Patent 980,559. Jan. 13, 1965. Priority date Sept. 14, 1961, Netherlands.

A calorimetric mass flow meter is described that has at least two groups of at least two tube members for conveying the flow to be measured. The tube members are parallel to one another, are close together, and extend between two blocks of heat-conducting material adapted to maintain the same temperature difference between the ends of all the tube members. Temperature-sensitive resistance elements are attached to the tube members in good thermal contact. The resistance elements of the tubes in each group are arranged for connection in a comparison circuit to measure the changes in resistance of the elements resulting from variations in the mass flow through the tubes.

The temperature-sensitive elements are sensitive, proportional not only to the mass flow through the tubes but also inversely proportional to the wall thickness. The resistance elements of individual tubes may be connected in a comparison bridge circuit separately or in groups one after another. The bridge circuit employs a common comparison resistance and measuring instrument so that many mass flows can be checked, registered, and/or controlled one after the other. The apparatus is suitable for use with a large number of simultaneously operated gas centrifuges. (B.L.M.)

30391 TUBULAR HEAT EXCHANGER ELEMENT WITH FINS. Ennemond Maillet (to Commissariat a L'Energie Atomique). British Patent 982,348. Feb. 3, 1965. Priority date Jan. 26, 1962, France.

A tubular element for a heat exchanger is described in which fins having a helicoidal curvature are arranged on the external surface of the element. The fins are arranged in an even number of identical sectors around the element parallel to each other in each sector and inclined with respect to each other in adjacent sectors so as to form a herring-bone pattern. Each sector of fins is carried by a portion of the external wall of the element that is delimited by two generator lines parallel to the axis of the element. Each of the portions has a part-cylindrical surface with its axis parallel to the axis of the element. The cross section of each portion taken along a plane at right angles to the axis of the element presents a general concavity that is directed towards the exterior of the element. The fins on each sector have their outer edges on an imaginary surface at a constant distance from the external wall surface of the sector. (B.L.M.)

30392 HEAT EXCHANGERS DISPOSED IN PRESSURE VESSELS OF CIRCULAR CROSS-SECTION. (to Sulzer Brothers Ltd.). British Patent 982,646. Feb. 10, 1965. Priority date Feb. 6, 1963, Switzerland.

A heat exchanger disposed in a pressure vessel of circular cross section includes a number of surface heat exchanger elements disposed side by side with their axes in the direction of the axis of the pressure vessel. Each element contains helically wound layers of tubes and is situated inside a cylindrical casing. The tubes are disposed around a cylindrical body that carries the tubes and the cylindrical casing. The cylindrical bodies are provided with supporting bases at the bottom end that have wheels, rollers, or the like to facilitate movement of the elements. Each element is readily removed through small apertures in the pressure vessel, and the elements are arranged in a hexagonal lattice that substantially fills the cross section of the vessel. (B.L.M.)

Materials Testing

Refer also to abstract 31462.

30393 (HW-80723) CREEP PENETRATION TESTING PROCEDURE. R. J. Evans (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Feb. 3, 1964. Contract AT(45-1)-1350. 9p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The design for an apparatus for determining the hot hardness of materials as a function of time, temperature, or load is given. The test is performed by applying the desired load (100 to 1000 lbs) to a 10 mm WC ball in contact with two samples. The apparatus is flushed with argon, heated to temperature in a nitrate salt bath, and the load applied for a set time. The final diameter of the indention is a measure of creep resistance and hot hardness and can be used on a comparative basis with other materials. (W.L.G.)

30394 ULTRA-STABLE EDDY CURRENT METHOD FOR DETECTING HYDRIDE IN ZIRCALOY-2. Donald R. Green (Battelle Memorial Inst., Richland, Wash.). Mater. Evaluation, 23: 279-84(June 1965). (HW-SA-3496)

A new eddy current method using a unique comparator circuit was applied to detect concentrations of hydride as low as 250 ppm by weight in Zircaloy-2. Absorption of 250 ppm hydrogen by the Zircaloy results in a 0.4 per cent increase in the resistivity which can be detected with the instrument. Lift-off compensation was attained by referencing the eddy current bridge to the center of curvature of the probe motion signal locus on the complex voltage plane. Drift usually inherent in the center of curvature method of lift-off compensation was eliminated. A discussion of the new circuit is included, and correlation between the circuit output and metallographic analysis of the hydride content of test pieces is shown. (auth)

Protective Structures

30395 (ORNL-TM-1154) MANUAL SHELTER-VENTILATING DEVICES FOR CROWDED SHELTERS COOLED BY OUTSIDE AIR—A PRELIMINARY REPORT. Kearny, Cresson H. (Oak Ridge National Lab., Tenn.). June 8, 1965. Contract W-7405-eng-26. 14p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

A recently invented shelter-ventilating punkah-pump which enables one person to pump manually over 5000 cubic feet per minute of air into a shelter can be made in home workshops using locally obtainable materials. A person with a few tools also can build efficient new directional-punkahs which can be used to cause directed air flows within a shelter of up to 10,000 cubic feet per minute and simultaneously to fan the shelter occupants. Thus, even in the hottest summer weather in the United States, the occupants of a crowded shelter can function as efficient evaporative coolers cooled by the evaporation of sweat, provided they also have adequate drinking water and salt. (auth)

30396 (SC-DC-65-1424) UNDERGROUND PROTECTIVE BUILDINGS. J. L. Colp (New Mexico Univ., Albuquerque). 1965. Contract AT(29-1)-789. 32p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A survey is presented of construction and design problems of underground protective buildings. Four types of buildings are considered: personnel shelters, launch silos, launch control buildings, and deep underground buildings. The conditions under which they must survive include weapon yields in the megaton and larger range, blast overpressures of 200 psi or less, and surface bursts. (D.L.C.)

Space Propulsion

See also REACTOR TECHNOLOGY — Propulsion and Space.

Refer also to abstract 31654.

30397 (NASA-CR-54240) THE PLASMA SEPARATOR ION ENGINE. Summary Report, April 1, 1963–June 30, 1964. B. A. Free, W. N. Neiman, and G. P. Kerr, Jr. (General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section). Mar. 15, 1965. Contract NAS 3-3561. 377p. (N65-19502). $7.00(CFSTI).

The inherent technical feasibility of the plasma separator engine has been demonstrated experimentally both in separate engine component development programs and in a final 50 hour engine run. Peak ion source performance has been established well above that of any other source under development, at levels of ionization above 99% and power costs well below 100 electron volts per ion, and a theoretical interpretation of source performance characteristics has been developed. Aerodynamic flow control from a single source is restricted by the geometrical requirements for efficient ion production, but a multiple source approach analytically has been shown to improve flow patterns considerably, assuming collisionless flow. The theory of magnetic flow control is outlined and the concept experimentally demonstrated. The best electromagnetic density patterns produced to date are superior to any single source aerodynamic pattern. Complete transmission of incident plasma through the separator electrode

with good optics has been experimentally observed many times. This behavior is not in accord with commonly accepted perforated plate optics, and a new theory of plasma extraction optics has been proposed to account for it. An engine run of 56 hours total duration was made with an overall thrustor efficiency of 83.1% at an engine specific impulse of 6360 seconds, using a predetermined level of propellant utilization. The propellant utilization was checked by a mass balance and the performance was verified calorimetrically. Existing separate component performance indicates that a thruster efficiency of 86.5% is available by simultaneous component optimization. The capabilities of the plasma separator engine operating at this level of performance have been evaluated for several missions, including Navigator, and are shown in Appendix II. Theoretical information is presented which shows that the low ion generation power required in the Plasma Separator Engine results in superior thruster efficiency in the low specific impulse region. (auth)

30398 EVALUATION OF ELECTRODE SHAPES FOR ION ENGINES. S. L. Eilenberg, W. Seitz, and E. Caplinger (Electro-Optical Systems, Inc., Pasadena, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 3: 866-72(May 1965).

Techniques for evaluating electrode geometries for use in ion engines are presented. These techniques include the use of a digital-computer program and an electrolytic tank. The study is separated into several problem areas, which include direct interception, charge-exchange interception, uniformity of emission, and beam collimation. Direct interception is discussed in terms of unsealed, sealed, and deactivated edges. The perimeter of the sastrugi geometry is given special attention for focusing the outermost beams. Charge-exchange trajectories are calculated. Because of the slope of field near the accel-aperture in an accel-decel system, the charge-exchange erosion pattern has features which distinguish it from direct interception. The consequences of this form of erosion are discussed. A possible solution to this problem is presented. The sastrugi geometry has some features that inherently produce nonuniform emission over part of its surface. The advantages and disadvantages of this characteristic are discussed, and electrolytic tank studies are described in which higher degrees of uniformity may be achieved if desired. In addition, digital-computer results are presented showing the wide variation of current densities over the sastrugi ionizer if full space-charge limited flow is achieved. The effect of the shape of the beam-plasma boundary on ion trajectories is also discussed. (auth)

30399 AN ANALYSIS OF THE NUCLEAR PROPULSION SYSTEMS IN SPACE — THE NUCLEAR ROCKET. Radames Venchiarutti. Comit. Nazl. Energia Nucl., Notiziario, 11: No. 3, 21-50(Mar. 1965). (In Italian)

The potential applications and development problems concerning the use of nuclear energy in rocket-propulsion systems are discussed. The status of theoretical and experimental work by the leading US experts engaged in this sector of activity is reviewed. (auth)

GEOLOGY AND MINERALOGY

General

Refer also to abstract 30191.

Natural Radioactivity and Fallout

Refer also to abstracts 29895 and 30136.

30400 (ANL-6971(p.83-8)) ENVIRONMENTAL RADIATION STUDIES. (Argonne National Lab., Ill.).

Progress is reported in environmental radiation studies. Data are presented on the content of ^{137}Cs and ^{90}Sr in samples of surface air, soil, foodstuffs, human bone, and human tissue collected in the Chicago area during 1963 and 1964, and the γ spectra of fallout in the upper atmosphere. Neutron activation analysis was used to determine the total Cu in soil and in plants grown on selected soils under controlled environmental conditions. (C.H.)

30401 (CEA-R-2738) RECHERCHES SUR LA CONTAMINATION RADIOACTIVE DES ALIMENTS D'ORIGINE ANIMALE. (Research into the Radioactive Contamination of Foodstuffs of Animal Origin). Lothar Leistner (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre de Etudes Nucleaires). Mar. 1965. 73p. (EUR-2226.f). Dep.(mn).

Available data relating to the transfer of the most important radionuclides from the environment through animal products to man were assembled. As these are not directly utilizable for the countries of the European Community, the changing ecological conditions are considered with emphasis on contamination of man by ^{131}I, ^{137}Cs, or ^{90}Sr. (139 references) (C.H.)

30402 (NP-14904) ESTUDIO DE EVOLUCION DE MATERIALES RADIOACTIVOS EN EL MEDIO TERRESTRE. Informe No. 133. (Studies of the Behavior of Fallout Material In Terrestrial Media. Report No. 133). Dan Beninson, Eric Vander Elst, and Esteban Ramos (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1964. 21p. Dep.(mn).

Data on the radioactivity in the surface air, soil, food, and human tissues in Argentina from 1959 through 1962 are summarized and tabulated. The data are discussed in the light of information on radioactive residues in fallout. (J.S.R.)

30403 (TID-21764) DAIRY FARM RADIOIODINE STUDY FOLLOWING THE PIKE EVENT. Delbert S. Barth and Joel G. Veater (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Nov. 23, 1964. 44p. Dep.; $2.00(cy), 1(mn) (CFSTI).

Following the underground Pike Event at the Nevada Test Site on March 13, 1964, a small amount of radioactivity accidentally escaped from the ground. The resulting radioactive cloud passed over two dairy farms in the vicinity of Las Vegas, Nevada. Arrangements were made with the managers of these farms to cooperate in a study of the uptake kinetics of ^{131}I in dairy cattle under normal dairy farming practices. Each herd was separated so that at each farm there were three cows eating fresh green chop with the remainder of the herd on hay and stored feed. Peak levels observed in the milk of cows on green chop were 420 picocuries per liter (pc/l) at one farm and 70 pc/l at the other with an apparent decay half-life of approximately four days for both. Peak levels in the milk of cows on hay were 70 pc/l at one farm and 40 pc/l at the other. The apparent decay half-life at the farm having the highest levels was approximately six days. (auth)

30404 CONTRIBUTIONS TO THE STUDY OF CHANGES IN THE β ACTIVITY OF THE VEGETATION AS A FUNCTION OF THE PLACE OF COLLECTION. G. Munteanu, S. Sisak, V. Parpala, D. Caramihu, and I. Inta (Polytechnic Inst., Brasov, Romania). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 15: 591-600(1964). (In Rumanian)

The beta activity of several different plants, such as spruce (picea excelsa), moss (Eurynchium) and grass, collected during the period from February 26, 1962 to January 20, 1963 at various points in and near the city of Brasov, Rumania, was determined, completing the measurements within two days after collecting the samples. The green mass was calcined at 800°C and was homogenized after cooling, determining the beta activity of the ashes by means of a counter. The results indicated that the beta activity is markedly dependent on the point of collection. The lowest activities were obtained with samples collected at the foot of the mountains, within the city. It was also found that the beta activity of the plants depends on the species; the Eurynchium exhibited the highest activity, followed by the grass. It is considered possible that in each region there may exist a species that could be used as an indicator of the radioactivity of the atmosphere. (TTT)

30405 COMPARATIVE STUDY OF DIFFERENT INDICES OF AMBIENT RADIOACTIVITY IN VALENCIA DURING THE PERIOD 1962-63. J. Catala, A. Garcia, R. Diez, R. Perez, and J. Cuesta (Instituto de Fisica Corpuscular, Facultad de Ciencias, Valencia, Spain). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 60: 211-18(Sept.-Oct. 1964). (In Spanish)

Measurements of air and rain water radioactivity have been carried out in Valencia during 1962 and 1963. The results from several types of measurements are compared to show the general trends of artificial radioactivity within this period. Some specific problems, such as the high activity of hot particles in the atmospheric dust were also studied. (auth)

30406 DISTRIBUTION OF RADIOACTIVITY IN MINERALS AND ROCKS OF THE ALNO ALKALINE AREA. von Eckermann, Harry. Arkiv Mineral. Geol., 3: 479-88(1964).

A radiation map was drawn for the central alkaline area on Alnön. This shows that no or only insignificant radioactivity has been added to the rocks, fenites, and nepheline syenites, etc. which are formed metasomatically around the central sövite body. The radioactivity that occurs is limited to the close vicinity of the sövite contacts. On the other hand high radioactivity was found in the sövite, reaching a maximum on Sälskären. This is due to the presence of the knopite-, perovskite-, dysanalyte- and pyrochlore-like minerals which must have been largely in existence when the lime-silica exchange between gneiss-granite and sövite began. Any free radioactivity is presumed to have been associated with fluorine with which it was transported across the contact into the host rock during metasomatism and bound up in minerals a relatively short distance from the sövite. To determine to what extent the minerals are carriers of the radioactivity, 47 minerals, including eight of the knopite-pyrochlore series, were isolated and their radioactivity measured in c/min. The general level of radioactivity established for both in situ and mobilized nepheline syenite cannot be entirely explained by a relative enrichment of ^{40}K but seems to be due to addition of potassium from the intrusive during the more regional metasomatic processes. Finally, autoradiograms showed that radioactivity in the kimberlite is mainly concentrated in small globules, now filled with carbonate but originally probably hydrocarbon and hydrogen fluoride bubbles or gas concentrations. (auth)

30407 CONCENTRATION OF WATER SAMPLES FOR DETERMINING TRITIUM CONTENT. Ya. D. Zel'venskii, D. A. Nikolaev, V. S. Tatarinskii, and V. A. Shalygin. At. Energ. (USSR), 18: 367-72(Apr. 1965). (In Russian)

The concentration of water samples was achieved using the rectification method under vacuum (~100 mm Hg). The enrichment with tritium was determined by variations of stable (oxygen and deuterium) isotope concentrations during

the fractionation of the sample. Two alternative methods are suggested: during the stationary state reaching the maximum possible separation, or during the non-stationary state with arrested enrichment. The best results of water fractionation (for tritium and heavy isotopes) were observed at 100 to 120 mm Hg. (tr-auth)

30408 A METHOD FOR CALCULATING RADIOACTIVE IMPURITIES IN WATER AND THE NON-CIRCULATING RESIDUE LAYER IN WATER BASINS. F. Ya. Rovinskii. At. Energ. (USSR), 18: 379-83(Apr. 1965). (In Russian)

Certain uniformities in migration and distribution of radioactive impurities were studied in non-circulating contaminated water basins. The capture of the impurity solutions by the residual layer was due to the ion exchange and molecular absorption processes. Equations were developed describing the variations in the concentration of radioactive isotopes as a function of time spent in the water and in the residue layer. The equations were used for estimating the content of ^{90}Sr, ^{106}Ru, and ^{144}Ce in non-circulating water basins. (tr-auth)

30409 CATTLE AS FALLOUT MONITORS: CESIUM-137 CONCENTRATIONS IN DESERT RANGE CATTLE. Clifton Blincoe, V. R. Bohman, and E. L. Fountain (Univ. of Nevada, Reno). J. Agr. Food Chem., 13: 157-60(Mar.-Apr. 1965).

Three herds of grade or purebred Hereford cattle were studied. The cattle in the two southern locations, DV (Delemar Valley) and NTS (Nevada Test Site), subsisted on range alone except for occasional concentrate feeding during the winter. The KC (Knoll Creek) herd was on range during the summer and fed locally produced native grass hay during the winter. In the spring and fall, after the first two years, five animals were sacrificed from each herd. During 1959, 1960, and 1961 the ^{137}Cs concentration in liver and muscle of range cattle decreased slowly. The values in 1962 were about one fourth of the 1958 values, reflecting the decreasing amounts of ^{137}Cs available in the biosphere, in agreement with data on humans. Little difference was observed in ^{137}Cs concentration, although the data from the NTS herd generally were slightly higher than from the other two locations. For example, the NTS muscle ^{137}Cs concentration in the fall of 1958 was 0.42 pC/g (range 0.39 to 0.71) and in the fall of 1961 was 0.15 pC/g (range 0.10 to 0.23), but the DV muscle ^{137}Cs concentration in the fall of 1958 was 0.21 pC/g (range 0.12 to 0.37) and in the fall of 1961 was 0.10 pC/g (range 0.05 to 0.18). Analysis of variance indicated this effect was significant. This may represent an increased deposition before 1959 of short-range fallout containing ^{137}Cs from tests conducted on the Nevada Test Site. During 1962 the ^{137}Cs concentration in range cattle increased in response to the resumption of nuclear weapons testing. At the DV and KC locations the increase was moderate. At the NTS location, the cattle were moved after the spring 1962 sampling, so as to be exposed to the max possible fallout resulting from testing on the Nevada Test Site. Cesium-137 concentrations in muscle and liver average 5.5 pC/g (range 3.5 to 8.9) and 2.3 pC/g (range 1.2 to 3.9), respectively. Precipitation at the KC location is about twice that of the other two locations, averaging 10 in./yr contrasted to an estimated 6.4 in. at the NTS and DV locations. This difference did not result in any obvious differences in ^{137}Cs concentrations in liver and muscle. Possibly the increased deposition at the dryer southern locations (DV and NTS) due to their proximity to the Nevada Test Site offset the expected increased deposition due to precipitation at the KC location. The muscle ^{137}Cs concentration was greater than that in liver. In all animals studied the concentration of ^{137}Cs was less than the maximum permissible concentration; hence the animals were considered fit for human consumption. (BBB)

30410 SILVER-110m AND COBALT-60 IN OCEANIC AND COASTAL ORGANISMS. T. R. Folsom and D. R. Young (Univ. of California, La Jolla). Nature, 206: 803-6(May 22, 1965).

With the use of a dual-crystal γ spectrograph, it was possible to measure recent ^{60}Co concentration-levels in many marine species, particularly in crustaceans and mollusks, without resort to chemical concentrating treatment. Another nuclide, ^{110m}Ag, was also found to be spread widely in the ocean and often concentrated more highly than ^{60}Co in digestive tissues of mollusks and crustaceans. The method for determination is described. Data are tabulated. (P.C.H.)

30411 TOTAL BETA RADIOACTIVITY, INCLUDING ^{90}Sr AND OTHER RADIONUCLIDES IN THE PLANKTON, MEASURED IN THE TYRRHENE SEA DURING THE FIRST OCEANOGRAPHIC CAMPAIGN OF THE M/N BANNOCK. Bruno Schreiber, Enrico Cerrai, Cesare Triulzi, and Laura Tassi-Pelati (Centro Informazioni Studi Esperienze, Milan). Rend. Ist. Lombardo Sci. Lettere, B, 98: 143-66(1964). (In Italian)

Measurements of the total β radioactivity were carried out on samples of plankton collected during the First Oceanographic Campaign of M/N Bannock. Several radionuclides, such as $^{90}Sr-^{90}Y$, $^{144}Ce-^{144}Pr$, $^{95}Zr-^{95}Nb$, ^{125}Sb, and ^{155}Eu, were also determined in these samples. Sea water was analyzed and the following radionuclides were found: $^{90}Sr-^{90}Y$, $^{144}Ce-^{144}Pr$, and ^{155}Eu. Tables which compare measurements of plankton samples from May 1961 to September 1963 are also given. Data of previous determinations on cuttlefish bones are also reported. The radiochemical procedures for the plankton and sea water samples are described. (auth)

30412 CONTRIBUTION OF ^{141}Ce, ^{144}Pr, AND ^{147}Pm TO RADIOACTIVITY IN THE SURFACE LAYERS OF COASTAL SEDIMENTS OF THE LIGURIAN SEA. Enrico Cerrai, Bruno Schreiber, Cesare Triulzi, and Laura Tassi-Pelati (Centro Informazioni Studi Esperienze, Milan). Rend. Ist. Lombardo Sci. Lettere, B, 98: 184-96(1964). (In Italian)

Radiochemical analysis of samples from marine sediments was carried out. The contribution of fallout radionuclides, such as $^{144}Ce-^{144}Pr$ and ^{147}Pm to the activity of upper layers of sediments was found to be significant. The presence of thorium in all layers of sediment was also ascertained. A diagram of the chemical separations is given. (auth)

30413 ON THE RADIOACTIVITY OF CERTAIN PLANTS FROM BUCHAREST REGION. I. I. Georgescu (Polytechnic Inst., Bucharest), V. Voljin, L. Ciohodaru, and G. Teodorescu. Rev. Roumaine Phys., 9: 867-91 (1964). (In French)

The radioactivity of the wild vegetation of the Bucharest region was studied in order to determine the degree of contamination by relatively long-lived fission products and the existence of a selectivity of the plants in the capture of some radionuclides. ^{137}Cs was identified in all the vegetation samples analyzed and in traces in wild brier leaves. ^{90}Sr was present in leaves of maple and polygonum; its presence is probable in leaves of acacia and oak and it is absent in the leaves and fruits of the wild brier, the leaves of clover, and the acorn (seed and shell). ^{144}Ce is present in all the leaves and fruits analyzed except the maple. In the samples of acacia its concentration reaches 1765 pc/kg green leaves; it is deduced that acacia leaves have a selectivity in the capture of Ce. It is probable that the leaves of the polygonum and the acorn capture selectively ^{140}La, which was detected in these samples in spite of its relatively short life. $^{95}Zr(^{95}Nb)$ was identified in leaves of the maple and oak. The presence of $^{106}Ru(^{106}Rh)$ in oak leaves was established only by gamma spectrometric analysis. The ratios Cs/K and Sr/Ca were established for some vegetation. The degree of contamination by fission products in some vegetation in the region of Bucharest does not exceed the tolerance limits. (tr-auth)

30414 MEASUREMENT OF TRITIUM IN RAIN, CITY WATER, GROUND WATER AND HOT SPRING. Tan Takahashi, Tatsuji Hamada, and Fumio Yamasaki. Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 59: 49-51(Mar. 1965).

Measurements were made of tritium in samples of rain, city water, ground water, and water from hot springs from

Oct. 1960 through 1964. The tritium in samples of 60 or 100 g was concentrated 10 to 15 fold by electrolysis and the final concentrate was counted as hydrogen. Data are presented in tables and graphs. (M.C.G.)

30415 GEOCHEMISTRY OF SOME NATURAL RADIOACTIVE ELEMENTS IN SOILS. V. I. Baranov, N. G. Morozova, K. G. Kunasheva, G. I. Grigor'ev, and V. I. Vernadskii (Inst. of Geochemistry and Analytical Chemistry, USSR). Soviet Soil Sci., No. 8, 733-40(Aug. 1963).

Studies were made of the average content of natural radioisotopes in soil groups of various climatic zones in the USSR and their distribution by genetic horizons. Soil samples were analyzed for radium and thorium by ordinary radiochemical methods. Data are presented in tables. Preliminary investigations showed that there was no significant deviation in the soil samples from the radioactive equilibrium between uranium and radium. The thorium content of different soils varied 400-fold and the radium content 100-fold, whereas the content in the underlying rock was within one order of magnitude. Organic matter was found to play an important role in the migration of radioelements. Soils rich in organic residues had the lowest Th : Ra ratio. (M.C.G.)

30416 PROBLEMS OF THE GAMMA LOGGING THEORY. Yu. I. Serikov (Inst. of Petroleum, Chemistry, and Gas Industry, Moscow). Tr. Mosk. Inst. Neftekhim. i Gaz. Prom., 50: 232-42(1964). (In Russian)

The apparent gamma readings from the natural radioactivity of a mineral layer during deep-well logging must be corrected in order to obtain the true readings. The factors having an effect on the gamma readings can be divided into three groups: those associated with the mineral stratum, such as the radioactivity of the mineral, the spectrum of the natural gamma radiation, the mineral density, the stratum width, and the angle of the stratum with the axis of the borehole; those associated with the borehole, such as the borehole diameter, the radioactivity of the drilling fluid, the diameter of the detector in the borehole, the thickness of the casing and of the cement ring, and the position of the detector in the hole (in the center of the hole or offset); and those associated with the detector, such as the detector diameter, length of the counter, spectral sensitivity of the counter, and scanning rate. The differential equation for the intensity of gamma radiation from an elementary volume is written thus: $dI_\gamma = p_\gamma q_m d_m R^{-2} \exp(-\mu R)\, dV$. Here p_γ is the gamma dose rate at a unit distance per unit weight of radium, and is taken to be 0.00825 $\mu r \cdot cm^2/hr$ per 1×10^{-12} g of radium; q_m is the specific radioactivity of the mineral in units of 10^{-12} g-equiv radium/g; d_m is the density of the mineral in g/cm^3; μ is the linear absorption coefficient in cm^{-1}; R is the distance in cm from the volume element dV to the point of measurement; and I_γ is the gamma intensity ($\mu R/hr$) at the point of measurement. An effective linear adsorption coefficient is used in place of the true linear adsorption coefficient in order to correct for gamma scattering. The equation is solved, and the gamma reading is given as a function of the specific activity of the mineral, the specific activity of the drilling fluid, the radius of the borehole, and depth of the detector. (TTT)

30417 URANIUM, RADIUM, THORIUM, IONIUM, STRONTIUM 90 AND CESIUM 137 IN COASTAL WATERS OF JAPAN. Y. Miyake, K. Saruhashi, Y. Katsuragi, T. Kanazawa, and Y. Sugimura (Meteorological Research Inst., Tokyo). p.127-41 of "Recent Researches in the Fields of Hydrosphere, Atmosphere and Nuclear Geochemistry." Tokyo, Maruzen Co. Ltd., 1964.

Coastal waters collected in Suruga Bay, Japan in 1960 and 1961 were analyzed for U, Ra, Th, ^{230}Th, ^{90}Sr, and ^{137}Cs. The ^{90}Sr content in the marine organism, Sergetes lucens Hansen, was also measured. Data are presented in tables and graphs. Values for ^{90}Sr varied from 0.04 ± 0.03 to 0.48 ± 0.04 $\mu\mu$C/l and for ^{137}Cs from 0.62 ± 0.12 to 1.20 ± 0.36 $\mu\mu$C/l. The value for ^{90}Sr in the marine organism was 0.1 $\mu\mu$C/g ash. The concentration of uranium in Suruga Bay ranged from 1.6 to 1.8 μg/l at the surface and increased with depth to 5 μg/l near the bottom. The content of radium was 0.3 to 0.6×10^{-13} g/l at the surface and 0.5×10^{-13} g/l at 1200 m. The content of thorium was 0.6 to 0.9×10^{-7} g/l and for ^{230}Th the values ranged from 2 to 7×10^{-12} g/l. (M.C.G.)

Techniques and Equipment

30418 (VESIAC-6796VU) ELASTIC AND ACOUSTIC WAVES RADIATED FROM CYLINDRICAL MEDIA ABOUT A POINT SOURCE. W. C. Meecham and John M. De Noyer (Michigan Univ., Ann Arbor. Acoustics and Seismics Lab.). Nov. 1963. 18p. $2.60(CFSTI).

The theory for three related problems is considered. These problems involve finding the radiation pattern from simple harmonic sources in various types of media geometries which can be represented by cylindrical surfaces. The first problem is a consideration of a point source on the axis of an elastic circular cylinder which is completely surrounded by an infinite elastic medium of different properties. The second and third problems are acoustic or two-fluid problems. A free surface is introduced in both these examples. The source region for the second problem is a fluid half cylinder with the free surface containing the axis of the cylinder and the source located below the axis. The last problem involves a truncated fluid cylinder with the axis normal to the free surface. No numerical values are obtained for the formal solutions presented. (auth)

30419 NEW METHODS FOR OIL EXPLORATION. Richard F. Meyer (Geological Survey, Washington, D. C.). Anal. Chem., 37: 27A-37A(June 1965).

Development of techniques for petroleum exploration is reviewed. Geological, geophysical, and geochemical methods are discussed and instrumentation is described. A density logging device using a ^{60}Co gamma source and detector and a gamma-neutron logging device using a neutron source, neutron detector, and gamma detector to record natural radiation from geological formations are described and schematic diagrams given. Nuclear log calibration pits are described. The electrical arrangement for an induction logging device and a two-receiver acoustic logging tool are discussed. (M.C.G.)

30420 ABSOLUTE DETERMINATION OF THE ACTIVITY OF TWO C-14 DATING STANDARDS. Karlen, Ingvar; Olsson, Ingrid U.; Kallberg, Per; Kilicci, Serap (Uppsala Univ.). Arkiv Geofysik., 4: 465-71(1965).

An absolute determination of the activity of the two most common ^{14}C standards (oxalic acid from NBS and "Wilhelm") was made with the proportional counter and electronic equipment that was previously used in the determination of the half-life of ^{14}C. Additionally, a series of relative measurements giving the ratio of the activities of the two standards was made using another proportional counter. (D.C.W.)

30421 ISOTOPIC CONSTITUTION OF ORE LEAD IN SWEDEN. Wickman, F. E.; Blomqvist, N. G.; Geijer, P.; Parwel, A.; v[on] Ubisch, H.; Welin, E. Arkiv Mineral. Geol., 3: 193-257(1963).

The isotopic constitution of 99 samples of lead-bearing minerals was determined by the lead tetramethyl method. All metallogenetic provinces distinguished previously on geological grounds are represented; in many cases several samples from the same occurrence were studied. Most samples are galena, but other lead-bearing minerals have also been used. Each metallogenetic province has a characteristic range in its isotopic constitution. With two exceptions, all provinces form homogeneous groups. The exceptions are the Skellefte district, where two occurrences show a great excess of radiogenic isotopes, and the Caledonian province, in which a small subprovince has isotope ratios characteristically different from the rest of the province. Identical ranges were found for the Skellefte and Ultevis districts, the Svecofennian of Central Sweden and the supposedly Gothian province, and the three different epochs of lead mineralization distinguished in the Svecofennian of Central Sweden. Each of the remaining provinces differs from the others quite distinctly. With regard to the

proportion of radiogenic isotopes there is a very marked difference between the Phanerozoic deposits and those of the Precambrian. All of the former deposits, with the sole exception of the above-mentioned Caledonian subprovince, show a great excess of radiogenic isotopes; in the Siljan district this excess reaches exceptional figures. Among the Precambrian occurrences, on the other hand, a distinct excess of radiogenic isotopes is very rare. Model ages of the lead-bearing minerals were calculated according to three frequently used methods, which give considerable spread in the calculated ages. The occurrences carrying an evident excess of radiogenic lead give negative ages. The relative order in age judged from the model ages was not inconsistent with current relative age interpretations based on geological field work. The absolute values of the model ages are comparable in magnitude to the absolute age determinations so far made on Swedish rocks and minerals by other methods. (auth)

30422 POSSIBILITIES OF A GAMMA-SPECTROMETRIC FIELD METHOD FOR GEOLOGIC-GEOPHYSICAL INVESTIGATION. N. V. Mochul'skii. Byul. Nauchn.-Tekhn. Inform. Min. Geol. i Okhrany Nedr SSSR, No. 1, 38-45(1963). (In Russian)

The primary gamma spectrum above 0.5 Mev differs for uranium-radium and thorium minerals, and gamma spectroscopy can be used in field explorations for these minerals. Two types of counters are used. A small STS-5 halide counter is surrounded by six other halide counters hooked up in coincidence. This counter has a weight of 3.5 kg, and can measure gamma intensities from 4 to 15,000 μr/hr. An anticoincidence counter with a more elaborate arrangement of counting tubes is used for quantitative determinations of uranium, radium, and thorium in samples reading as low as 14 μr/hr. This instrument weighs 12 kg. The ratio of hard gamma count to total gamma count is 0.11 for Ra ($\chi_{Ra} = 0.11 \pm 0.01$) on the first model and 0.08 ± 0.08 for the second model. The values of χ_{Th} are 0.23 and 0.24 ± 0.03, respectively. The separation coefficient $\eta = \chi_{Th}/\chi_{Ra}$ is about 2 for the first model, and 2.5 to 3 for the second model. This method of directly determining the uranium and thorium components of a mineral by measuring the hard gamma part of the total spectrum (>0.5 Mev) is simple, convenient, and inexpensive. (TTT)

30423 USE OF RADIOMETRIC METHODS IN THE PROSPECTING, EXPLORATION, AND INVESTIGATION OF CARBONATE DEPOSITS. N. V. Mochul'skii. Byul. Nauchn.-Tekhn. Inform. Min. Geol. i Okhrany Nedr SSSR, No. 3, 40-5(1963). (In Russian)

A large oval carbonate mass surrounded by a wide mineralized veined region was investigated by radiometric methods. The distribution of mineral ores in the carbonate mass was very inhomogeneous. The activity in the carbonate mass was due to the presence of thorium and uranium in pyrochlore and hatchettolite ore veins. Pyrochlore is the most widely disseminated ore. The gamma readings for the carbonate ore varied from 15 to 45 μR/hr, in general. The ankerite carbonate ore gave a maximum reading to 100 to 200 μR/hr on a general background of 20 to 50 μR/hr. The unmineralized portions of the calcite carbonate ore gave gamma readings of 3 to 15 μR/hr; the portions with pyrochlore mineralization gave readings of 50 to 200 μR/hr, and separate zones enriched in pyrochlore and hatchettolite gave readings of 400 to 3000 μR/hr. It was found that the content of $Nb_2O_5 + Ta_2O_5$ could be correlated with the gamma reading in samples giving a reading of 50 to 250 μR/hr (1000 to 2000 μR/hr in places) as follows: $Y = 0.0013X - 0.018$, where Y is the content of $Nb_2O_5 + Ta_2O_5$ in the carbonate, and X is the average radioactivity in μR/hr. This relation does not hold at lower gamma readings. (TTT)

30424 SOME POSSIBILITIES OF USING PHYSICAL NUCLEAR ANALYSIS METHODS IN GEOCHEMICAL PROSPECTING FOR ORE DEPOSITS. E. I. Zaitsev, V. I. Malyshev, et al. Byul. Nauchn.-Tekhn. Inform. Min. Geol. i Okhrany Nedr SSSR, No. 3, 75-80(1963). (In Russian)

Neutron activation analysis is generally used in geological prospecting. With a flux of 10^{12} neutrons/cm^2 · sec, the sensitivity can vary from 10^{-12} g/g for Eu and Dy, to 10^{-11} to 10^{-10} g/g for Ho, In, Ir, Lu, Mn, Re, and Sm, to 10^{-10} to 10^{-9} g/g for Sb, As, Br, Cu, Ga, Au, I, La, Pd, Sc, Na, Pr, Ta, Tb, Tm, W, and Yb, to 10^{-9} to 10^{-8} g/g for Ba, Cd, Cl, Cs, Co, Er, Ld, Ge, Hf, Ni, Os, P, K, Pb, Se, and Zn, to 10^{-6} to 10^{-7} g/g for Ce, Cr, Hg, Mo, Sr, Te, Tl, Nd, Pt, Ru, Ag, Sn, and Sr, and to 10^{-7} to 10^{-6} for Bi, Ca, Fe, S, and Si. The fluorine content can be determined by the fast neutron reaction $^{19}Fe(n,\alpha)^{16}N$. Express methods were developed for determining the Al content of an ore by an $^{27}Al(n,\gamma)^{28}Al$ reaction, and silica by the fast neutron reaction $^{28}Si(n,p)^{28}Al$. Tantalum at contents of 10^{-6}% and higher can be determined quantitatively by neutron activation. Low concentrations of U, Ra, Th, and K, and the Th/U ratio can be determined from the heights of the gamma peaks at 100, 240, and 340 kev, and 1.45 Mev, and by beta counting on a specially developed counter, which does beta and gamma counting at the same time. Solid-state silicon counters can be used to distinguish the 4.18-Mev alpha particles of ^{238}U from the 4.76-Mev alpha particles of ^{234}U. (TTT)

30425 USE OF TRITIUM, ^{14}C, ^{90}Sr, AND ^{137}Cs. N. Ya. Magata. Genshiryoku Kogyo, 9: No. 8, 13-16(1963). (In Japanese)

In recent years attempts have been made to use materials tagged with natural tritium of ^{14}C or radioactive elements accumulated in atmospheric precipitation from atomic or hydrogen bomb explosions for solving hydrographic problems. In studying terrestrial water balances, the reaction of tritium with water, of which tritium is a component part, and fractionation caused by isotopic effects in vaporization must be considered. Based on determinations of tritium, deuterium, and ^{18}O in atmospheric precipitation, river water, and ground water (South Africa), an average entrapment time of 30 years is suggested. For measuring ground water that moves very slowly, tritium alone, whose half-life is 12 years, cannot be used. ^{14}C-tagged material may be used but its initial concentration, and concentration changes must be determined by radioactive decay methods. Direct measurements of water movement with radioisotopes are difficult because of the reaction of the isotopes with materials in the water. However, two isotopes of one element, e.g., ^{89}Sr and ^{90}Sr, may be used since the ratio between them will not change with movement of the water. Runoff may also be determined by such a method. (IIC-M.G.)

30426 PRIMEVAL STRONTIUM-87/STRONTIUM-86 RATIO. Akimasa Masuda (Tokyo Univ.). Nature, 206: 609-10(May 8, 1965).

The results of calculations made for primeval $^{87}Sr/^{86}Sr$ ratio consistent with the observed Rb/Sr ratio (or corrected figures) and the observed $^{87}Sr/^{86}Sr$ ratio. The resultant, primeval $^{87}Sr/^{86}Sr$ ratios fell within a very narrow range, averaging 0.6965. In spite of the comparatively small difference between Pasamonte (0.7004) and the estimated (0.6965), it considerably effects the estimation of the Rb/Sr ratio from radiogenic ^{87}Sr, because the $^{87}Sr/^{86}Sr$ ratio found in basalts is approximately 0.705-0.710. (P.C.H.)

30427 AGE OF GRANITES FROM THE TIN PROVINCE OF INDONESIA. G. Edwards and W. A. McLaughlin (Shell Development Co., Houston, Tex.). Nature, 206: 814-16 (May 22, 1965).

Methods for the measurement of the age of granites from the Tin Province of Indonesia are discussed. Methods used were potassium-argon, rubidium-strontium, and uranium-lead. It was concluded that the 180 million year age obtained by the potassium-argon method on biotite of Billiton granite is a misleadingly simple interpretation of the time of the igneous activity. (P.C.H.)

30428 RADIOCARBON AGE OF A NEVADA MUMMY. Phil C. Orr and Rainer Berger (Santa Barbara Museum of Natural History, Calif.). Science, 148: 1466-7(June 11, 1965).

Skin tissue, bone collagen, and vegetal clothing from a

well-preserved Indian mummy from a dry cave in Nevada were analyzed radiochemically. The age is about 2500 years; the ages obtained for the various samples were in close agreement. (auth)

Thorium and Uranium Minerals

30429 (RME-99) MINERALOGY OF THE CAMERON AREA, COCONINO COUNTY, ARIZONA. S. Ralph Austin (Atomic Energy Commission, Grand Junction, Colo. Production Evaluation Div.). Sept. 1964. 102p. Dep.; $4.00 (cy), 2(mn) CFSTI.

Uranium deposits at Cameron, Arizona, occur in the Moenkopi Formation and the Shinarump and Petrified Forest members of the Chinle Formation, all of Triassic age, and in the Kayenta Formation of Jurassic (?) age. Commercial production is largely from sandy lenses in the Petrified Forest Member. Primary uranium was deposited in and near carbonaceous fossil logs as uraninite, preceded by marcasite and pyrite and succeeded by galena, greenockite, and pyrite. Calcite and covellite are primary and/or secondary. No conclusion as to the origin of primary uranium was reached. Oxidation produced the following secondary uranium minerals: schoepite; betazippeite; schroeckingerite; phosphuranylite; metatorbernite; meta-autunite; sabugalite; occasional carnotite, tyuyamunite, and metatyuyamunite; uranophane; beta-uranophane; boltwoodite; two unnamed minerals; and at least two minerals not yet identified. These uranium minerals are associated with sulfur, hematite, cobaltian wad, ilsemannite, limonite, atacamite, dolomite, malachite, barite, gypsum, bieberite, halotrichite, alunite, jarosite, metasideronatrite, copiapite, ferrimolybdite (?), chalcedony, and opal. Overall radioactive equilibrium of deposits and disequilibrium of hand specimens in either direction suggests that uranium was recently redistributed without significant loss despite an almost complete lack of vanadium to fix it. Recency of redistribution is confirmed by the occurrence of uranium minerals in Pleistocene gravel; contrasting disequilibrium in oxidized logs and surrounding halos; discovery, in only slightly lower levels, of unoxidized logs in equilibrium; and results of radiochemical equilibrium studies indicating ages of 4,500 to 9,000 years for secondary uranium concentrations. So-called bleaching, used as an ore guide, is due chiefly to oxidation products of sulfide deposits. Actual bleaching of clay by acid sulfate solutions from oxidizing sulfides also occurs, accompanied by alteration of montmorillonite to illite and possibly to kaolinite. Positive correlations between elements and uranium found by previous investigators are confirmed, and some are indicated by certain minerals: calcium by gypsum; manganese by wad; molybdenum by ilsemannite; copper by malachite and wad; cobalt by bieberite and wad; nickel by bieberite and wad; lead by galena; and cadmium by greenockite. Negative correlation of aluminum and titanium with uranium indicates less clay in ore zones. Usefulness of secondary minerals and bleaching of clay as ore guides results from redistribution of their constituent elements by the same acid sulfate solutions which redistributed uranium. (auth)

30430 NOTES ON THE MINERALOGY OF SWEDEN. 3. A DAVIDITE-THORITE PARAGENESIS ON THE ISLAND OF BJORKO, NORTH OF VASTERVIK, SWEDEN. Welin, Eric; Uytenbogaardt, Willem (Aktiebolaget Atomenergi, Stockholm and Vrije Universiteit, Amsterdam). Arkiv Mineral. Geol., 3: 277-92(1963).

A mineralogical investigation was made of davidite deposits on the island of Björkö in Sweden. The main part of Björkö is occupied by rocks of the quartzite series. The feldspathic quartzite appeared to predominate but it was often strongly transformed. The radioactive minerals were located in a small outcrop of fine to medium-grained grey-red quartzite. Black thorite and xenomorphic rutile occurred in feldspar-richer muscovite-bearing sillieren. Davidite and thorite occurred in an aplite vein next to its contact with a well-preserved, feldspar-poor quartzite. The radioactive minerals occurred in aggregates surrounded by quartz and muscovite. The thorite crystals were yellowish white and idiomorphic against the davidite aggregates. In an aggregate composed of thorite only, the crystals were a red-brown color. Diagrams are shown and data are presented in tables. (M.C.G.)

30431 URANIUM AND ARSENIC IN HYDROTHERMAL PROCESSES. V. E. Boitsov and T. M. Kaikova. At. Energ. (USSR), 18: 373-8(Apr. 1965). (In Russian)

A brief description is given of geological structure of hydrothermal uranium deposits and the mineral composition of the ores. The deposits are of sulfide-uranium type and show the evidence of multistage processes of mineralization. The singular characteristic of the ore is the presence of large amounts of a native arsenic which together with pitchblende forms paragenetic association. The analysis of mineralogical ore content and uniformity of the formation of paragenesis indicated a high-concentration of arsenic in hydrothermal solutions from which pitchblende was deposited at low temperatures close to the surface. (tr-auth)

30432 THE CONTENT OF URANIUM IN QUARTZ OCCURRING IN SOME LOCALITIES OF TAITUNG. Hwa-sheng Cheng, Ching-yue Lin, and Chiung-huei Ke (National Tsing Hua Univ., Hsinchu, Taiwan). J. Chinese Chem. Soc. (Taiwan), 11: 185-92(Dec. 1964).

Recently it was found that copper-containing quartz occurring in north Taitung exhibited measurable radioactivity, the origin of which turned out to be U. The results of the analysis of U in the copper-uraniferrous quartz is reported. The first samples of quartz, obtained in 1962, registered on a GM counter an activity of 20 to 30 cpm per g of finely pulverized powder. Analysis showed that U was the cause of radioactivity. The copper-uraniferrous quartz was light green, with intermittent thin, brown stripes of iron. The U content of these brown stripes was lower than that of the other portions, indicating that U was accompanied chiefly with Cu. Samples from another area contained more Fe and less U than those found in samples from the first area. An outstanding feature of the copper-uraniferrous quartz is its rough appearance, though it is very hard. On the other hand, the copperferrous quartz, which contains no U, appears very smooth and lustrous. The copper-uraniferrous quartz samples are scattered on the ground surface in the second area while the harder copperferrous quartz constitutes an underground bed. The determination of U was carried out by separating ^{140}Ba activity produced by fission of ^{235}U after neutron irradiation of the samples in the THOR reactor. The quartz samples from the first area averaged 0.015 to 0.035% U. It was apparent that the inclusion of Fe decreased the U content to a value one- to two-thirds of the content in the portion containing no Fe. Qualitatively, however, it was concluded that U is accompanied by Cu and the presence of Fe hinders the U inclusion. (TCO)

30433 STRUCTURAL CONTROL OF URANIUM-BEARING VEIN DEPOSITS AND DISTRICTS IN THE CONTERMINOUS UNITED STATES. Frank W. Osterwald. Geological Survey Professional Paper 455-G. 1965. 29p. $0.30(GPO)

Uranium-bearing veins in the United States are principally fissure-filling deposits in faults, joints, or fracture zones that have resulted from compressive, tensile, or torsional stresses. The individual ore bodies within vein deposits are tabular sheet masses or ore shoots along veins, irregular stock-works along fault zones, or pipe masses either in fault intersections or in blocks of broken ground. Many veins consist of gouge or breccia containing uranium minerals. Rocks adjacent to faults, joints, or fault zones may also contain uranium if they are porous or reactive, or if they are broken. Most uranium-bearing vein districts in the United States are in structural environments in which subsidiary intermediate-to small-scale faults and folds are related spatially to large-to-intermediate-scale folds, anticlinal uplifts, crystalline-rock masses, or faults. Deposition of uranium commonly occurs late in the structural history of a district. (auth)

30434 URANIUM-BEARING LIGNITE AND CARBONACEOUS SHALE IN THE SOUTHWESTERN PART OF THE

WILLISTON BASIN—A REGIONAL STUDY. N. M. Denson and J. R. Gill. With a Section on HEAVY MINERALS IN CRETACEOUS AND TERTIARY ROCKS ASSOCIATED WITH URANIUM OCCURRENCES. W. A. Chisholm. Geological Survey Professional Paper 463. 1965. 80p., illus., maps, diagrs., tables, and portfolio. (GPO)

Uranium in carbonaceous shale and lignite occurs at many horizons throughout 2,500 feet or more of Upper Cretaceous and lower Tertiary (Paleocene and Eocene) rocks in the southwestern part of the Williston basin. The uranium occurrences extend northward 150 miles or more in general alinement with the structurally lowest part of the basin from Harding and Perkins Counties in northwestern South Dakota to the western part of Dunn County in southwestern North Dakota. The carbonaceous host rocks containing the higher grade occurrences range from 6 in. to 2 ft or more in thickness and are characterized by lenticularity, relatively high ash contents (35 to 40%), and low heating values. The important reserves of ore-grade uraniferous lignite and carbonaceous shale containing greater than 0.1% uranium are present in the North Cave Hills and Slim Buttes areas of Harding County, S. Dak., and in the Little Missouri River escarpment area (Rocky Ridge and Saddle Butte localities) in eastern Billings and northwestern Stark Counties, N. Dak. In these areas blanket-type deposits, containing in excess of 150,000 tons of ore-grade material, and lentil-type deposits of higher grade material, containing from a few hundred pounds to as much as 1,500 tons, were reported. Some of the deposits in the Cave Hills and Little Missouri River escarpment areas are overlain by relatively thin overburden which make them amenable to strip mining. Inferred reserves of ore-grade material in the region exceed 1 million tons. Chemical analyses of 10 large samples of uranium-bearing lignite and carbonaceous shale collected by the Atomic Energy Commission from Billings County, N. Dak., indicated an average content of 0.18% uranium, 0.3% molybdenum, 0.09% phosphorus, and 0.01% vanadium. Only 2 of the 10 large samples analyzed contained less than 0.1% uranium. Primary structural and stratigraphic controls affecting the localization of uranium appeared to be shallow troughs superimposed on the flanks of the basin by late Tertiary tectonic movements and by the proximity of the host rocks to the pre-Oligocene erosion surface. The localization of uranium in the Williston basin, as in the Colorado Plateau and Texas Coast Plain, was influenced by the presence of carbon. Porosity of the lignitic host materials and the enclosing rocks were important secondary controls of mineralization. From a study of the spectrographic, chemical, and mineralogic data and of the principal structural and topographic relations of the deposits, it was concluded that uranium, arsenic, molybdenum, selenium, vanadium, and some other elements were introduced into the lignite by ground water. An origin of these elements in the volcanic constituents composing the tuffaceous rocks is suggested. All significant occurrences of uranium in the region fall to within about 200 feet stratigraphically of the base of the tuffaceous sequence or to its projected base in areas where erosion has removed the tuffaceous sequence. Microscopic studies of 135 grab samples from the continental basin-fill sedimentary rocks comprising the Hell Creek, Fort Union, Chadron, Brule, and Arikaree Formations revealed a characteristic heavy-mineral assemblage for each formation that differs from the assemblage in the adjacent formation. No relation was found between any of these assemblages and the occurrence of uranium. (auth)

HEALTH AND SAFETY

See *also* BIOLOGY AND MEDICINE — Radiation Hazards and Protection.

Refer also to abstracts 30528, 30531, 30625, 30882, 31459, 31530, 31567, and 31596.

30435 (AECL-2233) CONTAMINATION CONTROL AND WASTE DISPOSAL IN HIGH-LEVEL ISOTOPE OPERATIONS AT AECL. A. F. Trott (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Apr. 1965. 18p. (CONF-650604-4). $0.50(AECL).

From International Symposium on Working Methods in High-Activity Hot Labs., Grenoble, France.

Ten years of operating experience handling multi-kilocurie quantities of ^{60}Co and other isotopes in a plant near the center of the city of Ottawa and remote from radioactive waste disposal facilities is reviewed. Contamination control, including ventilation design, continuous effluent air monitoring and filtration, continuous effluent water monitoring, in-cell monitoring and contamination control, liquid and dry waste processes and removal from hot cells, and the removal, packaging, and transportation of waste from the plant site to burial are described. (auth)

30436 (AERE-R-4810) EXPERIMENTAL WORK AT A.E.R.E. ON THE DEVELOPMENT OF PACKAGING FOR RADIOACTIVE MATERIALS WHICH WILL MEET THE I.A.E.A. REGULATIONS. F. E. Dixon and A. H. Partridge (Atomic Energy Research Establishment, Harwell (England)). Apr. 1965. 38p. Dep.; $1.40(BIS), 7s.(HMSO).

This series of experiments covers work performed since 1962 when the report TCAP/P 64/65 covering the earlier work was published. The two more important series of experiments are those covering (1) the development of expendable type "B" packaging and (2) tests leading to the development of a ventilated type B large source package. Other tests covered plastic packaging, small packages for exempt quantities of fissile materials, the three-ton drop test, model tests, and pressure tests. (auth)

30437 (ANL-6945) ENVIRONMENTAL RADIOACTIVITY AT ARGONNE NATIONAL LABORATORY. REPORT FOR 1962 AND 1963. J. Sedlet and F. S. Iwami (Argonne National Lab., Ill.). Jan. 1965. Contract W-31-109-eng-38. 62p. Dep.; $3.00(cy), 2(mn) CFSTI.

Results are presented from the environmental monitoring program at Argonne National Laboratory during 1962 and 1963. The purposes of the program are to measure the natural radioactive content of the ANL site and its surroundings, and to determine the origin, identity, and magnitude of any radioactivity not naturally present. Of primary interest is the detection of radioactive materials released to the environment as a result of Argonne operations. The outstanding feature in the radioactivity of the environment during 1962 and 1963 was the relatively high level of fallout activity resulting from the U.S.S.R. tests in 1961 and 1962 and the U. S. tests in 1962. Fallout averaged somewhat higher in 1963 than in 1962, although there was no atmospheric testing during 1963. By the end of 1963 the expected decrease in fallout was noted. The fallout activity, as measured by the beta activity in 24-hour air-filter samples, averaged 6.7 pC/m^3 in 1962 and 7.2 pC/m^3 in 1963. From 1953, when routine measurements of this type were begun, through 1961, the annual averages have ranged from 0.5 pC/m^3 in 1954 to 4.1 pC/m^3 in 1961. The amount of fallout activity deposited by precipitation was also relatively high, approximately 2500 mC/sq mi during 1962 and 1963. From 1953 to 1961, the annual totals varied from 640 mC/sq mi in 1960 to about 950 mC/sq mi in 1961. The highest total recorded was 11,000 mC/sq mi in 1952. Most of this activity was carried down by a rainfall in June 1952. Most of this activity was carried down by a rainfall in June 1952, which occurred a few days after an atmospheric nuclear detonation in Nevada. In 1962, the amount of fallout activity in air reached a peak in April and May and again in November and December. The increase in the spring was the combined result of a spring maximum in stratospheric fallout of fission and activation products produced in the fall of 1961, and of tropospheric fallout of fission products produced in tests conducted in the spring of 1962. The bulk of the fission products detected in the spring of 1962 originated in the U. S. Pacific tests. The increase in fallout activity in the fall of 1962 was due primarily to fission products produced by USSR tests conducted at that time. In 1963, a spring maximum was again evident in April, May, and June. During the second half of the year, the fallout activity in air decreased steadily, from an average of 12.4 pC/m^3 in June to 1.0 pC/m^3 in December. (C.H.)

30438 (GAT-R-359) HEALTH AND SAFETY ACTIVITIES REPORT FOR 1964. (Goodyear Atomic Corp., Piketon, Ohio). May 10, 1965. Contract AT(33-2)-1. 69p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Health and safety activities during 1964 included fire prevention and control, medical examinations, industrial hygiene activities, and health physics activities, including personnel and environs monitoring. Administrative organization of the activities is outlined and data are tabulated. (C.H.)

30439 (MLM-1241) ENVIRONMENTAL MONITORING REPORT: JULY–DECEMBER 1964 AND 1964 SUMMARY. P. C. Adams (Mound Lab., Miamisburg, Ohio). Dec. 31, 1964. Contract AT(33-1)-Gen-53. 18p. Dep.; $1.00(cy), 1(mn) CFSTI.

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, is presented for the second half of 1964 and a summary is presented for the entire year. The concentration of tritium in the Great Miami River was within the maximum permissible concentration recommended by the National Committee on Radiation Protection and Measurements. The average concentration of polonium released did not exceed the maximum permissible continuous concentration. The concentration of polonium and plutonium in the environmental air was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during this period. (auth)

30440 (NP-15064) DATA FROM RADIATION PROTECTION PROGRAMS. VOLUME 3, NUMBER 2. (Department of National Health and Welfare, Ottawa (Ontario)). Feb. 1965. 36p.

Data are summarized on the radiation exposure of radiation workers in Canada from 1958 through 1960 as determined by analysis of film monitoring data. The highest values were observed in industry, but very few individuals exceeded the maximum permissible annual dose. Data are presented on radioactivity due to fallout in samples of air, precipitation, and milk collected during January 1965, with emphasis on the content of ^{137}Cs and ^{90}Sr in milk. Reactor environmental monitoring data for January 1965 are included. (C.H.)

30441 (NP-15066) CONTROL OF RADIOACTIVE FALLOUT IN WATER SYSTEMS. A MANUAL FOR WATER ENGINEERS. (Department of National Health and Welfare, Ottawa (Ontario). Emergency Health Services). 1965. 128p. Dep.(mn)

This manual shows how to assess the amount of radioactive contamination which could enter water supplies by various routes and how to estimate the reduction of contamination by water purification methods. Relevant techniques are presented together with the necessary graphs, charts, and other data which will enable water engineers to survey their own systems. (D.L.C.)

30442 (ORNL-TM-1136) OPERATING EXPERIENCE OF THE NUCLEAR SAFETY INFORMATION CENTER,

MARCH 1963–MARCH 1965. J. R. Buchanan and Wm. B. Cottrell (Oak Ridge National Lab., Tenn.). May 17, 1965. Contract W-7405-eng-26. 57p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A review is presented of the first two years of Nuclear Safety Information Center (NSIC) operation. It describes the services that the Center offers, the manner in which it operates, and problems it has encountered. NSIC stores its information both in a manual file and, since September 1964, on magnetic tape at the Oak Ridge IBM-7090 facility. The efficient services made possible by the computer are described. (auth)

30443 (RFP-501) PLUTONIUM OXIDE SHIPPING PACKAGES. F. E. Adcock, J. T. Byrne, and R. L. Delnay (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Apr. 28, 1965. Contract AT(29-1)-1106. 87p. Dep.; $1.00 (cy), 1(mn) CFSTI.

Two packages for shipping plutonium oxide have been designed, constructed and tested to meet requirements of AEC Manual, Chapter 0529 for transport by common carrier. These same two packages meet the currently proposed regulations, 10 CFR 71, for licensees. One package developed during this program meets the requirements for Class I shipments of plutonium oxide. The Bureau of Explosives issued permit number 1967. Although by Class I definition, a single shipment may contain an infinite number of these packages, the physical limitation of vehicles and the monetary value of the oxide set a practical limit on the number of packages per shipment. The other package qualifies for Class II shipments. The Bureau of Explosives issued permit number 1976. A nuclear safety analysis indicates 146 damaged packages are safe for shipment. However, the calculated "radiation unit" limits these packages to 133 per shipment. Actual radiation measurements will set the number of packages per shipment if the dose rate in mr/hr exceeds the calculated "radiation unit." A brief cost analysis shows that plutonium oxide shipments are more economical than nitrate shipments. Since plant facilities and operating techniques were beyond the scope of the study, only shipping and package costs were evaluated for a 20-kg plutonium shipment. (auth)

30444 (USNRDL-TR-834) DEVELOPMENT OF DESIGN CRITERIA FOR ROOF WASHDOWN SYSTEMS: A STUDY OF THE RELATIONSHIP OF SLOPE TO PARTICLE TRANSPORT BY WATER FILMS. R. H. Heiskel, R. J. Crew, and N. J. Vella (Naval Radiological Defense Lab., San Francisco, Calif.). June 4, 1964. Contract CDM-SR-59-54. 44p.

Previous studies covered the transport of particulate matter by various water flow rates on an ideal surface at one of five slopes from 0 to 0.165. This study covers the relation of slope to transport on an ideal surface. On a near-horizontal surface, no transport occurs when the water flow rate is insufficient to produce turbulent flow. The slightest slope causes particles to be transported at low water flow rates in laminar flow. Surface waves, which are present at all slopes under most flow conditions, increase transport rate. An empirical equation is presented for the computation of the transport velocities of both spherical and irregular shaped particles. The maximum amount of particulate matter that can be transported is presented. (auth)

30445 AIR IONS MEASURED IN ROOMS WITH ENHANCED CONTENTS OF NATURALLY PRODUCED RADON. Siksna, Reinhards (Uppsala Univ.). Arkiv Geofysik., 4: 345-57(1965).

By measurements of the concentration of ions and the content of radon in the air from different rooms of the Institute of High Tension Research at Uppsala, it was shown that the air is considerably contaminated by ions and radioactive elements. Inconvenience caused by such air while making electrometrical measurements is noted, and possibly hazardous effects on human welfare and general health are indicated. (auth)

30446 RADIOACTIVITY IN DIET. Conn. Med., 18: 12(Apr. 1964).

Levels of radioactivity in the average diet of Connecticut residents are reported. These levels are within safe limits. In a sample daily diet, served at a private school in the state during the week ending February 25, 1964, ^{131}I was so low as to be undetectable. Strontium-89 levels were also so low as to be undetectable, and ^{90}Sr levels were at 42 pC/day. Foods tested in the school sample included: cereal, egg, toast, orange section, shredded cabbage, rolls, butter, mixed vegetables, potato, chicken with dressing, spinach, asparagus, melon balls, coffee, tea, and milk. For evaluation of the significance of estimated intake levels, they were compared with those of the Federal Radiation Council Guide. These daily intakes based on total daily food intake, averaged over a year, are considered an acceptable health risk for large general population groups for a lifetime: ^{131}I–100 pC/day, or 12-month total of 36,500 pC; ^{89}Sr–2000 pC/day, or 12-month total of 730,000 pC; and ^{90}Sr–200 pC/day, or 12-month total of 73,000 pC. Airborne radioactivity levels remained low during the week ending February 25, 1964. The average daily airborne radioactivity for the Hartford area was 2 pC/m^3 of air. Although air sampling does not lend itself to direct evaluation of biological hazards, the measurement of β radioactivity in air does provide one of the earliest and most sensitive indications of increases in environmental radioactivity. (BBB)

30447 RADIATION ACCIDENTS. PART II. IS THERE A PREVENTION? V. THE PROBLEM OF PROTECTION. A. FROM WAR TIME EXPLOSIONS. HOW MANY PEOPLE ARE INVOLVED? Joseph D. Goldstein (Walter Reed Army Medical Center, Washington, D. C.). Conn. Med., 28: 266-8(Apr. 1964).

To the question, how many people will be involved in a radiation accident, there is no simple answer. Any answer depends on: (1) The circumstances of the event (sudden, intentional vs accidental, release of uncontrolled nuclear energy–a nuclear weapon detonation). (2) The purpose for the prediction (the kinds and numbers of injured which will require medical care, referred to as the medical load). Clinically, the effects may manifest themselves over a range from severe, combined mechanical, burn, and radiation trauma through a wide spectrum of injuries down to mild or subclinical ionizing radiation exposure. Predominantly ionizing radiation injuries with some concomitant mechanical trauma would make up the principal medical load from small nuclear weapons such as the Davy Crockett. Nominal sized weapons (as used in World War II) should contribute a combination of all three types of injuries: mechanical, thermal, and ionizing radiation. Megaton weapons probably would result in shifting the make-up of the medical load toward an increase in thermal injuries with a lesser increase in mechanical injuries. Environmental factors will affect the amount of ionizing radiation delivered to the individual because of variable shielding factors. Environmental differences, whether natural, structural, or personal, could modify the medical results by either diminishing or increasing vulnerability to blast, thermal, or ionizing effects. Another important factor is time (time during which a person can take evasive action by changing his environmental setting.) This is especially true when dealing with downwind fallout. The importance of the time factor becomes greater with large weapons capable of having fallout patterns extending a few hundred miles. Also considered are the factors of distance and shielding. Thus the amount of injury sustained by an individual will be a function of the distance (or shielding), therefore, time between the point where the injurious agents are released and the point of physical occupancy of the host. The number of casualties may be estimated before a nuclear event by a method of superimposing the ranges of the various weapon effects as an idealized pattern over a given target. Variables such as weather, season, warning time, and state of preparedness cannot be neglected, but introduction of such multiple, although essential, variables demonstrates the uncertainties inherent in predicting how many people will become casualties. Other factors, such as rescue, may strongly influence the magnitude of the medical problem. In spite of its in-

adequacies, a prediction of the medical load is a useful tool when due consideration is given to the limitations of the method employed for making the prediction. This quantitative appraisal, when combined with the types of casualties generated, helps define the problem. The statement of the problem is of value to medical planners when it is related in time and space to an estimate of predicted medical resources. (BBB)

30448 RADIATION ACCIDENTS. PART II. IS THERE A PREVENTION? V. THE PROBLEM OF PROTECTION. B. FROM PEACETIME REACTORS. THERE ARE PEOPLE TO PROTECT. Hugh F. Henry (DePauw Univ., Greencastle, Ind.). Conn. Med., 28: 269-70(Apr. 1964).

The principal hazard of a criticality accident is the possibility that nearby individuals may be suddenly exposed to neutron and γ radiation. The problem of personnel protection at a criticality excursion is complicated by the fact that the accumulation of excessive fissionable material in a favorable configuration may not involve a readily recognizable physical change such as temperature or color. There is essentially no known way to measure an approach to criticality, nor is there an obvious and readily recognizable indication that an accident has occurred in all cases. Essentially the only action that an individual can take to limit his own exposure following a criticality accident is to get away from the site as quickly as possible. To provide effective medical treatment, it is necessary to separate high-exposure from low-exposure patients. This separation may be readily made if each individual in the operating facility routinely carries a few grams of a neutron-sensitive metal. These neutron-sensitive foils are sufficiently activated by even low neutron exposures so that the resultant β-γ emission can be readily detected with a simple survey meter. There is no simple device which an individual may wear to provide a method for readily determining his radiation exposure by a factor closer than about 3 to 6. Probably the best method of dose determination involves blood Na activation evaluations coupled with information obtained from a system of area dosimeters placed throughout the facilities. Whole-body counts have also been suggested, and may give a closer indication of the dose received, but are time-consuming and require considerable evaluation skill. Contamination of the air and surfaces by fission products and other radioisotopes during and following an accident may present problems in addition to those from direct radiation. Some administrative actions, important to personnel protection in locations where criticality accidents can occur, are outlined. Some protection preparations for a criticality accident, even the slightest possibility of its occurring, are also enumerated. (BBB)

30449 RADIATION ACCIDENTS. PART II. IS THERE A PREVENTION? V. THE PROBLEM OF PROTECTION. C. IN ROUTINE CLINICAL PRACTICE. THE RADIOLOGIST AND RADIATION HAZARDS. Herbert D. Kerman. Conn. Med., 28: 271-3(Apr. 1964).

A general brief evaluation of the somatic and genetic effects of ionizing irradiation of man is attempted, and means for reducing exposure in radiologic practice are discussed. Protection must be afforded to three general categories of personnel: the patient, the physician and technicians employing radiation, and the innocent bystander. For patient protection the radiologist should use factors that combine to permit an examination that reveals the most diagnostic information with the least possible exposure. Patient protection involves stringent adherence and meticulous attention to relatively simple and readily available procedures and techniques. By far, the most important feature is the proper indication for a radiation exposure to avoid unnecessary radiographic examination. Radiographic examination of the pregnant abdomen and the gonadal areas of persons in child-bearing age should be undertaken only for compelling medical reasons. Routine x-ray examination should be avoided, and periodic x-ray surveys should be restricted to high-yield groups. Competent technique entails accurate limiting and filtration of the primary x-ray beam, and use of the most sensitive combination of films, screens, developing chemicals and temperature, and of high kilovoltage that will permit satisfactory contrast. The reduction of the number of films and fluoroscopy time of each examination is also extremely important. The physician's protection of himself and technicians is a matter of discipline in following the rules of time, distance, and shielding. Fluoroscopy should be kept to a minimum and those in the fluoroscopic room should wear aprons. Use of Ra is a particularly difficult exposure problem, and extraordinary care in the use of barriers, remote handling equipment, rapidity, dexterity, and prior planning is essential to reduce exposure. Also considered is the protection of the innocent bystander, such as the secretary in the next office, the clerk in the office below, and the receptionist in the corridor. The principal factors in protection are the same as for the radiologist, i.e., time, distance, and shielding. (BBB)

30450 RADIATION ACCIDENTS. VI. WHAT DOES THE REST OF THE WORLD THINK? FOREIGN OPINIONS ON NUCLEAR ACCIDENTS. Marshall Brucer. Conn. Med., 28: 274-9(Apr. 1964).

Views are presented from authoritative spokesmen of ten countries on means provided in their countries for prevention of nuclear accidents and measures for treating casualties should they occur. Statements are provided from Switzerland, Sweden, Venezuela, Japan, England, China, Hong Kong, India, New Zealand, and Australia. In summation, it is pointed out that the U.S., U.S.S.R., England, France, and China already have atomic weapons. The U. S. alone has about 25,000 tactical (less than one-kt) warheads and about 7000 to 10,000 large (Mt-range) warheads. Canada, Japan, Israel, India, a number of Scandinavian, European, and British Commonwealth countries, probably even Egypt, could produce them on about a year's notice. There are between 250 and 300 reactors in the U.S., and about the same number are in operation or are being planned in other countries. There are almost 1600 large teletherapy installations through the Western world. Behind the Iron Curtain it can be assumed that about half as many are available as in the Western countries. There are at least 500 large accelerators and about 50 other multikilocuries radioisotope sources, about 1000 therapeutic x-ray machines, and about 10,000 diagnostic machines in use. Between 10,000 and 100,000 patients are being treated with radioisotopes annually; the diagnostic doses probably approach a million annually. If it were uncontrolled (it is highly controlled and very safely handled), there is enough reactor waste being produced to poison the oceans. The extraordinary safety record of the atomic energy industry in the past has been due to meticulous precautions. However, with the increasing use of reactors there will undoubtedly be accidents in the future. (BBB)

30451 RADIATION ACCIDENTS. VII. SOURCES OF INFORMATION. AN ANNOTATED BIBLIOGRAPHY ON THE RADIATION ACCIDENT PROBLEM. Marshall Brucer. Conn. Med., 28: 280-5(Apr. 1964).

This annotated bibliography is divided into eight major sections listing sources of information; bibliographic references are contained within the body of the text. Each of the eight major sections is subdivided into three classifications (Introductory, Intermediate, and Advanced). The Introductory books are usually general statements of the problem. The Intermediate documents are within the scope of the usual training of physicians. The Advanced statements are usually definitive. The eight major headings are as follows: I. Basic Radiation Physics; II. Health Physics Manuals and Expositions; III. Compilations of Data; IV. Instrumentation; V. Radiation Biology; VI. Laboratory Methods and Guides; VII. Nuclear Medicine Texts; VIII. Radiation Accidents (The Medical Problems). For each of the 58 texts listed, publication data are included, as well as a brief review of the contents and its general applicability to various classes of readers (untrained persons, physicians, physicists). Many of the advanced texts are highly technical and beyond the understanding of the average physician, for whom this bibliography was compiled. (BBB)

30452 BETA AND GAMMA RADIOACTIVITY MEASUREMENTS, Sr^{90} DETERMINATION IN PLANKTON AND SEA WATER SAMPLES COLLECTED DURING THE OCEANOGRAPHIC CAMPAIGN OF M/N BANNOCK–SUMMER 1964. B. Schreiber and L. Tasi Pelati (Universita, Parma, Italy). Energia Nucl. (Milan), 12: 330-2(June 1965).

Beta and gamma radioactivity was measured on the ashes of a plankton sample collected during the Oceanographic Campaign of M/N Bannock carried out in summer 1964, in the western Mediterranean Sea. Moreover ^{90}Sr content was determined in plankton and sea water from the same cruise. The curve of beta decay and the gamma spectrum concerning plankton are reported, as well as the results obtained from the radiochemical analysis for ^{90}Sr compared with those obtained previously. The hypothesis that ^{90}Sr accumulation is to be ascribed mainly to the presence of protozoa was confirmed. (P.C.H.)

30453 REMOTELY CONTROLLED MONITOR. Itsuo Morita and Tateo Kasai (Kobe Kogyo Corp., Japan). FAPIG (Tokyo), No. 34, 246-9(Oct. 1964). (In Japanese)

The telemetering system for monitoring the atmospheric radioactivities and the radiations directly from radioactive facilities may be divided in two groups, according to the method of transmitting the signals obtained by the radioactivity detectors. In the wireless telemetering system, the carrier waves cannot be modulated directly for the extremely short pulse signals (~50 μsec), but this difficulty can be overcome by computing the counts cumulatively in the remotely controlled monitoring station. In the wire telemetering system, on the other hand, although it is impossible to send the signals without amplification of 1 km. or more, the wire (75Ω) can transmit the pulse signals (as a current pulse) directly. The four kinds of multiple transmission systems are discussed in detail. Descriptions are also given of the similar wire and wireless telemetering systems of the JAERI. (NSA of Japan)

30454 THE ARTIFICIAL RADIOACTIVITY IN THE PRECIPITATIONS AND TRIBUTARIES OF THE SEA OF CONSTANCE AREA AND ITS DISTRIBUTION IN WATER, ORGANISMS, AND SEDIMENTS OF THE SEA. [PART] II. Werner Voss. Gas-Wasserfach, 105: 1098-1100(Oct. 2, 1964). (In German)

The study on the radioactivity in the area of the Sea of Constance was completed. Discussion is given on the radioactivity of the biological material and mud and data are tabulated. (J.S.R.)

30455 THE ARTIFICIAL RADIOACTIVITY IN THE PRECIPITATIONS AND TRIBUTARIES OF THE SEA OF CONSTANCE AREA AND ITS DISTRIBUTION IN WATER, ORGANISMS, AND SEDIMENTS OF THE SEA. [PART] I. Werner Voss. Gas-Wasserfach, 105: 934-9 (Aug. 21, 1964). (In German)

In order to determine completely the distribution, exchange, and residence time of radioisotopes in large waters, the total $\alpha + \beta$ activity in the precipitations, tributaries of the Sea of Constance, the sea itself, and its organism was investigated from 1960 to 1963. The measurement devices and methods and the preparation of the samples are reported. The results obtained for the precipitation, sea water, and tributaries are tabulated and discussed. (J.S.R.)

30456 THE RADIOACTIVITY OF ILLUMINATING GAS FROM SHALE. A. K. Aunap and U. L. Peinar. Gigiena i Sanit., No. 1, 90-2(Jan. 1965). (In Russian)

The radioactivity of natural gas was determined by direct counting, and compared with the radioactivity of aerosols filtered from ordinary air. The short-lived activities showed an alpha count of 1.7×10^{-15} to 1.1×10^{-14} Curies/l, and a beta count of 5×10^{-16} to 8.7×10^{-15} Curies/l in the natural gas. A comparison count of the radioactive aerosols in air gave an alpha count of 1.4×10^{-14} to 7.9×10^{-14} Curies/l, and a beta count of 8×10^{-14} to 6.4×10^{-13} Curies/l. The alpha count due to long-lived radioactivities was $<1 \times 10^{-15}$ Curies/l in the natural gas compared to 8.0×10^{-17} Curies/l in air. The beta count of the long-lived component is 5×10^{-17} Curies/l in the natural gas compared to 2.2×10^{-15} Curies/l in air. The radioactive content of natural gas is a factor of 10 to 100 times less than the radioactive content of air. (TTT)

30457 USE OF AN ELECTRIC HAND VENTILATOR (ARV-49) FOR TAKING SAMPLES OF RADIOACTIVE AEROSOLS FROM THE ATMOSPHERE. R. Ya. Maslovskii, V. G. Dorofeev, and Yu. G. Sliba. Gigiena i Sanit., No. 2, 57-9(Feb. 1965). (In Russian)

In taking air samples under field conditions near a source of contamination, an electric fan (ERV-49) specially equipped to operate off the rear wheel of an automobile is used to suck in the large quantities of air required to obtain a sufficient amount of radioactivity on the filter. The electric motor is removed from the blower and is connected to the rear automobile wheel by means of a rubber coupling. The rear wheel of the car is jacked up, and the carburetor is adjusted to give an air collection rate of 300 m^3/hr. A total of up to 5800 liters of air per minute can be sucked through the filter. The equipment is convenient and reliable to use in operation. (TTT)

30458 LEGISLATION AND ORGANIZATION OF HEALTH PROTECTION AGAINST IONIZING RADIATIONS IN ITALY. Gaetano Del Vecchio and Lidia Failla (Ministero della Sanita, Rome). Igiene Sanita Pubblica (Rome), 20: 64-94(Jan.-Feb. 1964). (In Italian)

The development of legislation and regulatory agencies in Italy relating to protection of the population against radiologic hazards is surveyed. The bases for these control measures in the recommendations of international committees are discussed. The interrelations between various governmental agencies in Italy having an interest in radioprotection control are outlined. The functions of various agencies in detection, surveillance, and inspection of radiation sources are presented. The locations of the 35 stations in Italy which monitor fallout β radiation levels are shown. Maps also show the 16 stations where radioactivity levels in milk are assayed, the 28 stations for measuring levels in rainfall and drinking water, the 34 stations monitoring fission products in air, the eight stations measuring radioactivity in grain, soil, and forage, and the 18 stations monitoring sea and irrigation water. Charts are provided showing fluctuations in β activity in various media in Italy from 1958 to 1963, as measured by these national networks. Some proposals for improving the organization of radioprotective facilities in Italy are presented. (BBB)

30459 THE ROLE OF THE SOUTHERN INTERSTATE NUCLEAR BOARD IN RADIATION PROTECTION. Robert H. Clifford (Southern Interstate Nuclear Board, Atlanta) and Maxwell Dauer. Ind. Med. Surg., 34: 147-50(Feb. 1965).

The organization and function of the Southern Interstate Nuclear Board is discussed, especially with regard to radioprotection. It is an instrumentality of the 17 states comprising the Southern Governors' Conference. Although other groupings of states are now in the process of developing regional science programs using the Southern Interstate Nuclear Compact as a model, this Board presently is the only non-federal, public-supported, interstate advisory and development agency in the United States in the areas of nuclear energy, space, and related technologies. The SINB is a coordinating agency concerned with the orderly development of technical industry to advance the economic and social wellbeing of the states individually and collectively, and at the same time support national goals. With respect to radiation protection, the Board has no direct regulatory responsibility. However, it provides a means by which the broad implications of radiation protection can be considered on a multi-state and multi-agency basis. The SINB is primarily interested in full exploitation of atomic energy for economic gain; however, it recognizes the requirements of radiation protection. (TCO)

30460 CONTROL OF THE INCORPORATION OF IRRADIATING SUBSTANCES BY MEANS OF EXCRETION ANALYSIS. A SUMMARY. Arpad Toth (Uranegeszsegugyi Szolgalat, Pecs, Hungary). Magy. Radiol., 16: 363-74(Dec. 1964). (In Hungarian)

A summary is presented of the advantages of the analysis of excreta over external body measurements for estimation of internal contamination from radioisotopes. Mathematical formulae showing the relation between the amount excreted and whole-body burden are also presented and explained. Tables and graphs are presented on the excretion analysis of various isotopes such as U and Ra; Rn breath analysis, Po urine analysis, data on human excretion of Po, and measurements on ^{89}Sr. Some excretion analysis methods described indicate that measurements usually give values in the picocurie range, therefore great care should be taken in collecting, storing, processing of samples, and avoiding contamination. Urine samples should be collected over a 24-hr period; in case of possible contamination at industrial sites samples should be collected during the week, not on weekends. Concentration methods include evaporation, precipitation, coprecipitation, solvent extraction, electrochemical analysis, electric and nonelectric or spontaneous deposition, ion-exchange chromatography, distillation, and adsorption. A combination of concentration and scintillation measuring procedures is described. It is essential to know the time span covered by the sampling, the type of irradiating substance involved, and the sensitivity accuracy of measuring devices, to minimize errors in analysis. One disadvantage of excretion analysis is the difficulty of collecting and measuring samples accurately, and it is suggested that air, drinking water, and excretion analysis should be conducted simultaneously to obtain accurate figures. However, excretion analysis permits reasonably precise measurements and may be carried out at small institutions, although whole-body counters are preferable for estimation of some internally deposited radioisotopes. (BBB)

30461 CALCULATION OF MAXIMUM PERMISSIBLE CONCENTRATIONS OF BETA-ACTIVE GASES IN THE AIR OF WORK PREMISES AND IN THE ATMOSPHERE. G. M. Obaturov. Med. Radiol., 10: No. 4, 42-9(Apr. 1965). (In Russian)

The MPC of beta activity for confined atmospheres is 1 to 2 orders higher than for outside. The MPC for a limited space with all factors taken into consideration is higher than for an infinite half-space without such consideration, e.g., 20-fold on ^{41}Ar. The effective radius of the isotope has little effect. The chief danger in an enclosed space is to the crystalline lens on the short-lived isotopes, because of the high beta energy, and to the skin for long-lived isotopes, because of the relatively low beta. The data indicate that the MPC for work rooms is much higher for some isotopes than health physics standards permit, but for populated places is lower. (tr-auth)

30462 THE RISKS PRESENT IN THE DIFFUSION OF LARGE QUANTITIES OF TRITIUM IN THE ATMOSPHERE. A. Doury (Commissariat a l'Energie Atomique, Saclay, France). Minerva Nucl., 9: 1-6(Jan.-Feb. 1965). (In French)

Data are reported on the quantities of tritium normally encountered in nature and the processes by which hydrogen and its isotopes are susceptible to diffusion in the troposphere. Some theoretical studies are presented on the maximum concentrations that could be a consequence of accidental discharges of great quantities of tritium in the atmosphere. The possibility of continuous discharge is also considered. A hypothesis of the speed of isotopic exchange between gaseous tritium and steam from water is suggested and the orders of size of doses of external or internal irradiations risked during a stay in a contaminated area are given. (auth)

30463 AEROPLANE CONTAMINATION FROM STRATOSPHERIC FALL-OUT. L. Argiero, S. Manfredini, and G. Palmas (Camen, Pisa, Italy). Minerva Nucl., 9: 7-10(Jan.-Feb. 1965). (In Italian)

The origin, nature, and diffusion of fallout, which is responsible for possible contamination of high-flying aircraft, is discussed. Results of the few measures taken internationally up to the spring of 1961 to prevent contamination of aircraft and to remove the contamination are summarized. The controls carried out and the results personally obtained in Italy are illustrated and discussed. (auth)

30464 STATISTICAL INVESTIGATIONS OF THE INDIVIDUAL DOSES AS RECORDED BY PHOTOGRAPHIC DOSIMETRY. G. Busuoli, A. Cavallini, A. Cervellati, C. Melandri, and O. Rimondi (Comitato Nazionale per l'Energia Nucleare, Bologna). Minerva Nucl., 9: 13-16 (Jan.-Feb. 1965). (In Italian)

The doses recorded on about 63,000 film badges were analyzed statistically. The results showed that the individual doses recorded in medical environments are consistently higher in relation to characteristic working conditions. A number of measures aimed at diminishing the individual doses in these environments are suggested. The results of an investigation of the exposure to neutrons showed that the gamma dose is only accidentally associated with the fast neutron dose. (auth)

30465 DECONTAMINATION OF A HOT CELL. HEALTH PHYSICS CONSIDERATIONS. C. Cortissone, C. Serafini, and S. Tagliati (Comitato Nazionale per l'Energia Nucleare, Casaccia, Italy). Minerva Nucl., 9: 16-22(Jan.-Feb. 1965). (In Italian)

The decontamination of a hot cell in the Hot Laboratory of the Casaccia Nuclear Studies Centre of CNEN is described. The radioprotective principles adopted, the organization of various check-ups, and the results obtained are explained. Some considerations, which can be used in other similar operations, were drawn from the experience gained in this case. (auth)

30466 THE HEALTH PHYSICS SERVICE IN A NUCLEAR RESEARCH CENTRE. L. De Franceschi and S. Marchi (CAMEN, Pisa, Italy). Minerva Nucl., 9: 32-6 (Jan.-Feb. 1965). (In Italian)

The object of the health physics service in a nuclear research center is to ensure, by means of controls, interventions, assistance, and measures, that all the operations accompanied by radiological danger are carried out with the minimum personnel exposure to ionizing radiations and minimium exposure of surrounding populations. The controls and interventions are aimed at having the radiological norms observed by all the personnel. If necessary they can exercise the right of veto on operations, which are held to be contrary to the norms or which are judged to be too dangerous. The assistance is aimed at providing all those with problems regarding personal defense against ionizing radiations with advice and adequate equipment for solving these problems (evaluations of doses, stages of work, selection of protective clothing, ad hoc nuclear measures, etc.). The measures carried out enable all possible sources of ionizing radiations to be kept under complete control, as regards safety and protection of personnel and the surrounding populations, so that a physical check can be made to assure that everything is carried out in the due manner and that the measures cover the situation minute to minute. A type of organization is suggested and a definition of the responsibilities suitable for accomplishing the tasks of the health physics service is given. (auth)

30467 NETWORKS FOR THE CONTROL OF ENVIRONMENTAL RADIOACTIVITY IN ITALY. M. M. Ferraris and F. G. Giorcelli (Comitato Nazionale per l'Energia Nucleare, Casaccia, Italy). Minerva Nucl., 9: 40-6(Jan.-Feb. 1965). (In Italian)

A description is given of the networks for the observation of radioactivity organized for the investigation of environmental radioactivity of CNEN and now operating on a nation-wide scale in regard to the following: milk, fresh water, sea water, soil, fodders, cereals, irrigation water, meat, and vegetables. The methods of sampling (number and geographical location of the sampling points, rate of sampling, type and quantity of samples taken, etc.), and the degree of representativeness of the samples, are described for each network. The various treatments applied to the samples (desiccation, ashing, chemical separation, etc.) and the measurements made (beta counting of pure nuclides and gamma spectrometry) are described. (auth)

30468 EXTERNAL EXPOSURE FROM FALLOUT DEPOSITED ON THE GROUND AND THE PROTECTING EFFECT OF RESIDENTIAL STRUCTURES. Mikio Yamashita, Setsuko Matsuda, and Hironobu Watanabe. Nippon Genshiryoku Gakkaishi, 7: 232-41(May 1965). (In Japanese)

An evaluation was made on the external exposure from fallout deposited on the ground. Infinite plane dose rates were calculated for the case of ^{137}Cs and ^{60}Co sources taking into consideration the build-up effect of γ rays. The protecting effect against radiation from fallout provided by wooden residential structures is discussed in terms of the protection factor, defined as the ratio of the exterior dose rate (infinite plane dose) to the dose rate in the structure interior. The interior dose rates were calculated taking account of the geometrical shielding effect and the barrier shielding effect. Utilizing the results of calculation, examples are given of the protection factor for simple geometrical configurations of structures and of fallout distribution. (auth)

30469 CONTROL OF LUMINOUS DIAL WATCHES IN NEW YORK CITY. Ira R. Paul (Public Health Service, New York). Radiol. Health Data, 4: 263-7(May 1963).

New York City's efforts to limit the public exposure from Radial timepieces began on March 19, 1958, with the enactment of Article 175 of the New York City Health Code which prohibited the storage, manufacture, repair, handling, or use of any timepieces, instruments, novelties, or devices, if done in such a manner that any person is exposed to radiation dose rates in excess of limitations recommended by the National Committee on Radiation Protection and Measurements. These dose rates were interpreted to limit the radiation emission through the front surface of pocket watches to no more than 0.1 mrad/hr and the radiation emission through the back surface of wrist watches to no more than 1.0 mrad/hr. It was estimated that pocket watches are worn for an average of 100 hours per week, 50 weeks/yr, facing the body in a pocket near the belt-line. Wrist watches may be worn with the back surface in contact with the skin of the forearm for about 150 hr/week. Using the NCRP dose rates as a guide for control at the radiation source rather than at the organ of interest, if a pocket watch is worn for 5000 hr/yr, and the maximum permissible dose (MPD) is 0.5 rem (500 mrem), then the emission rate at the surface of the crystal should be a max of 0.1 mrad/hr. If a wrist watch is used for 7500 hr/yr, and the MPD is 7.5 rem (7500 mrems), then the emission rate at the surface of the back should be a max of 1.0 mrad/hr. Numerous wrist watches were tested and, with the exception of some skin-divers watches, were found to fall within the established limits. Measurements of watches were made with an end-window G-M survey meter, but more precise measurements were made by use of autoradiographs on personnel dosimeter film. Any person desiring to purchase a watch that emits radiation in excess of the specified limits may do so by demonstrating a legitimate, professional need and securing a permit from the New York City Department of Health. (BBB)

30470 THE MEASUREMENT OF DOSE IN PEOPLE. Klaus Becker (Abteilung Strahlenschutz, Kernforschungsanlage, Julich, Ger.). Roentgen Bl., 15: 161-79(May 1962). (In German)

Radiation protection control includes both direct and indirect methods. Indirect methods include monitoring of air, water, soil, and foodstuffs for presence of radioactive materials that might be taken up by a population, or control of dose sources, shielding control, or medical supervision of personnel. Direct methods of radioprotection are based on direct measurement and estimation of radiation dose in persons. To measure the dose received from external radiation sources, film dosimeters and pocket dosimeters are generally used. More recently developed methods for this type of measurement are glass dosimetry or neutron energy pulse detectors. In order to measure internally deposited sources of irradiation two approaches are generally used. These are external measurements made with whole-body counters and analyses of excreted radioisotopes. The whole-body counter is the most important equipment available for measurements of routinely incorporated radioisotopes, but its use is restricted because of its cost and unavailability. Unfortunately, it is not useful for detection of Pu, ^{90}Sr, ^{3}H, ^{14}C, or ^{35}S. For these and other radioisotopes, excretion measurements are necessary. These vary in complexity and accuracy, and often it is impossible to correlate the amount of excretion with the remaining body burden. (BBB)

30471 PSYCHOLOGICAL AND HUMAN FACTORS IN A PHOTOGRAPHIC RADIOPROTECTION SERVICE. G. Spiegler. Roentgen Bl., 16: 25-7(Jan. 1963). (In German)

General procedures and factors which must be taken into account in order to carry out properly an institutional radioprotection program that uses film badges are discussed. Usually, the intensity of film darkening produced by exposure to radiation makes a much greater impression on working personnel than a statement of exposure in terms of mr alone. The older employee or user of radioisotopes may have become accustomed to working under conditions where unnecessary exposure was experienced. This person must be reminded of the protective measures that must be taken to reduce exposure to tolerance limits or below. In general, all radioisotope users must be made to realize the feeling of security and reassurance that consistent and thoughtful usage of film badges is intended to give. In the radioprotection program the character and the type of person in charge will be decisive for its successful impact or its failure. (BBB)

30472 ON THE EFFECTS OF A "NEUTRON BOMB." R. Dolder (Kantonsapotheke, Zurich). Vierteljahresschr. Schweiz. Sanitaetsoffiziere, 40: 95-7(Aug. 1963). (In German)

With each atomic explosion there is neutron production. Whenever the neutron irradiation that results reaches the earth, the amount of radioactivity induced is independent of atmospheric conditions, and it is related to the magnitude of the explosion. For example, 12 hr after a 20-kt H bomb explosion there is still a danger zone of ~735 m from induced radiation. This represents residual radioactivity from an explosion which is greater than the fallout. A neutron bomb may produce greater contamination of the earth than either an A bomb or an H bomb. In addition, the radioactivity induced may vary considerably with the type of materials exposed to the neutron irradiation. For instance, alloys that contain Cu may become very radioactive, or steel objects, such as tanks, may be made unfit for use, even though they may be undamaged mechanically. In this instance, personnel who operated such equipment would be intensely irradiated. Similar conditions would hold also for other weapons, machinery, or foodstuffs. Personnel would be extensively and probably fatally irradiated by explosion of a neutron bomb, and tools or machinery could not be reused until the radioactivity induced decayed to tolerance levels. (BBB)

30473 AN IMPROVED CHEST PHANTOM FOR STUDIES OF PLUTONIUM AND AMERICIUM IN HUMAN LUNGS. R. G. Speight, C. O. Peabody, and D. Ramsden (Atomic Energy Establishment, Winfrith, Dorset, Eng.). p.115-30 of STI/PUB/84(Vol.I). (AEEW-R-359)

Work is in progress on the problem of measuring plutonium and americium isotopes, either separately or as mixtures, in the human lung. They may be present as point or distributed sources and are detected directly by their low energy x and gamma rays. The high absorption in the soft tissue (ribs, sternum, spine, etc.) makes it difficult to correlate the response of external detectors with a configuration of internal sources. A semi-empirical method must therefore be used in which sources are placed inside a realistic phantom having similar dimensions and absorption properties to the human chest. The design and construction of such a phantom are described and its method of use illustrated. Experimental results are given for the photon absorption of the constructional materials at energies down to 9.25 kev. Their degree of equivalence to human tissue is discussed. (auth)

30474 SAMPLING AND ANALYSIS FOR ASSESSMENT OF BODY BURDENS. J. H. Harley (Atomic Energy Commission, New York). p.155-67 of STI/PUB/84(Vol.I).

A review of sampling criteria and techniques and of sample processing methods for indirect assessment of body burdens is presented. The text is limited to the more recent developments in the field of bioassay and to the nuclides which cannot be readily determined in the body directly. A selected bibliography is included. The planning of a bioassay program should emphasize the detection of high or unusual exposures and the concentrated study of these cases when detected. This procedure gives the maximum amount of data for the dosimetry of individuals at risk and also adds to our scientific background for an understanding of internal emitters. Only a minimum of effort should be spent on sampling individuals having had negligible exposure. The chemical separation procedures required for bioassay also fall into two categories. The first is the rapid method, possibly of low accuracy, used for detection. The second is the more accurate method required for study of the individual after detection of the exposure. Excretion, whether exponential or a power function, drops off rapidly. It is necessary to locate the exposure in time before any evaluation can be made, even before deciding if the exposure is significant. One approach is frequent sampling and analysis by a quick screening technique. More commonly, samples are collected at longer intervals and an arbitrary level of re-sampling is set to assist in the detection of real exposures. It is probable that too much bioassay effort has gone into measurements on individuals at low risk and not enough on those at higher risk. The development of bioassay procedures for overcoming this problem has begun. (auth)

30475 HANDBOOK OF FEDERAL REGULATIONS APPLYING TO TRANSPORTATION OF RADIOACTIVE MATERIALS. (Atomic Energy Commission, Washington, D. C.). 1965. 93p. $0.35(GPO).

This handbook is for use in locating and understanding Federal regulations applying to the shipment of radioactive materials. Portions of pertinent regulations of the Interstate Commerce Commission, Federal Aviation Agency, U. S. Coast Guard, and Post Office authorities are given together with unofficial comments on the proper application of the regulations. Auxiliary information for shippers is also included. (D.L.C.)

30476 STUDIES WITH Ra SOURCES. P. Rueth. Thesis, Leipzing, Universitat, 1963. 64p. (In German). $2.00 (Gmelin, AED-DISS. 63-752).

Dose distributions from Ra needles were measured using an ion chamber. Distribution of activity inside the needles was studied by photographic methods. (Gmelin Inst.)

30477 NUCLEAR ACCIDENT DOSIMETRY AT ARGONNE NATIONAL LABORATORY. L. L. Anderson, T. L. Duffy, J. Sedlet, and D. P. O'Neil (Argonne National Lab., Ill.). Vienna, International Atomic Energy Agency, World Health Organization, 1965, Preprint No. SM-56/5, 18p. (CONF-650302-17).

From IAEA Symposium on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation, Vienna.

A summary is presented of current planning at Argonne with respect to dose determination following a criticality incident. The discussion relates chiefly to two types of commercially obtained dosimeter packages, and includes the results of independent calibrations. The primary dosimeter system incorporates threshold detectors for neutron spectrum measurement. Fission foil decay calibration curves have been determined experimentally for scintillation counting equipment routinely used at Argonne. This equipment also has been calibrated for determination of sodium-24 activity in blood. Dosimeter units are deployed as secondary stations, and data from the neutron activation components of these units will be used to make corrections to the neutron spectrum for intermediate as well as thermal energies. The epicadmium copper foil activation, for a given fluence of intermediate energy neutrons, has been shown relatively insensitive to neutron spectrum variations within the region, and a meaningful average of copper cross section has been determined. Counter calibration factors determined at Argonne are presented for the copper, indium, and sulfur components. The total neutron influence is computed using the corrected spectrum in conjunction with a capture probability function and the blood sodium result. One or more specifications of neutron dose then may be calculated by applying the spectral information to the appropriate conversion function. The gamma portion of the primary dosimeter package contains fluorescent rods and a thermoluminescent dosimeter in addition to a two-phase chemical dosimeter. The gamma dosimeter in the secondary package is a polyacrylamide solution which is degraded by exposure to gamma radiation. The absorbed dose is derived from a measured change in solution viscosity. Difficulties in evaluation, placement, and storage stability are discussed. Plans have been formulated to determine phosphorus-32 in biological materials in order to obtain a fast neutron dose, to analyze environmental materials for neutron activation products, and to determine the total number of fissions. A manual for the facilitation of administrative control of dose determination is discussed. (auth)

30478 PERSONNEL ISOLATION AND PROTECTION SYSTEM. Paul Webb. British Patent 983,423. Feb. 17, 1965. Priority date Apr. 27, 1960, United States.

A garment enclosure is provided as a protective system for isolating a person from a dangerous atmosphere while maintaining maximum mobility of the person. The outer garment is essentially impermeable to the atmosphere from which protection is desired. A transparent visor is positioned for external visibility of the wearer. A passage means is provided for a circulating flow of air through the enclosed volume. A portable power means wholly contained within the outer garment is provided for the circulating means. An air reconditioning unit is mounted on the person within the outer garment and includes a CO_2 absorber and a device for cooling and condensing excess moisture from the air. A makeup quantity of oxygen is supplied to the reconditioned air to maintain the proper atmosphere in the garment at all times. (B.L.M.)

30479 IMPROVEMENTS IN OR RELATING TO CONTAINERS FOR RADIOACTIVE MATERIAL. Armand Aupetit, Paul Blum, and Jacques Jouin (to Commissariat a l'Energie Atomique). British Patent 986,344. Mar. 17, 1965. Priority date July 6, 1960, France.

A container for dispatching radioactive materials is made up of a body consisting of two stainless steel chambers with lead filling the space between. The exterior of the container is equipped with devices for handling purposes, and a base plate with a rubber cushion is affixed to the bottom of the container for support. The inner stainless steel chamber bounds a cavity in which a basket is disposed for carrying the radioactive materials. The basket is made up of perforated Al tubes welded together. The cavity is closed by two covers. The first cover is of the manhole-lid type made of stainless steel and locked in a fluid-tight fashion over the cavity. The second cover is made of lead covered with stainless steel and has a toroidal shaped air-chamber on its lower surface opening onto the first cover. This air-chamber facilitates the tightening down of the packings to make a second air-tight seal with the container. Ducts closed with a double fluid-tight seal provide communication between the exterior of the container and the cavity of the inner chamber. (B.L.M.)

INSTRUMENTATION

General

Refer also to abstracts 29839, 30354, 30355, and 31476.

30480 (AEET/ED/SG/16) SOME CONCEPTS INVOLVING THE NEW CRITERION AND THE POSSIBLE EXTENSION TO TYPE 0 AND TYPE 2 SYSTEMS. B. Vedanthachar (Atomic Energy Establishment, Trombay (India). Electronics Div.). Dec. 20, 1962. 12p. Dep. (mn).

A previously developed criterion is defined which judges the performance of a linear servomechanism in terms of stability, μ_0, and velocity gain; μ_0 is the largest value of μ resulting in an overshootless response for the test limit defined for positive time by $1-e^{-\mu t}$. The existence of μ_0 for a linear servo is established by considering negative values of μ. The nature of μ_0 for a critically stable system is discussed. The possible extension of the criterion to type 0 and type 2 systems is described. The generalization to any linear system is also indicated. (M.J.T.)

30481 (AEET/ED/SG/17) ANALOG COMPUTOR DESIGN OF SLOW-SPEED SATURATING SERVOMECHANISMS WITH COULOMB FRICTION. B. Vedanthachar (Atomic Energy Establishment, Trombay (India). Electronics Div.). Feb. 7, 1963. 17p. Dep.(mn)

A third-order saturating servomechanism with Coulomb friction was studied on an analog computer. The system considered was a servo with two real time constants and an integration in the open loop transfer function; it was assumed that torque saturation is due to amplifier saturation only. Considerations of nondimensionalization, block diagram, and test input are discussed. The analog computer set-up is described, including block diagram, choice of scale factors, saturation element, observation of nonlinear characteristic, and signum component. Results on variations of the velocity constant, the amplitude of the limit cycle oscillation, and the effective Coulomb friction torque at the load are discussed. (M.J.T.)

30482 (BNL-9241) HIGH-CURRENT SWITCH WITH BUILT-IN LINEAR TIMER (IH-386 AND IH-398). J. P. Palmer and S. C. Goscinski (Brookhaven National Lab., Upton, N. Y.). May 20, 1965. Contract AT-30-2-GEN-16. 6p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A simple, fast high-current switch is described for heating a filament to a controlled high temperature for a controlled time for studies of chemical reactions. The switch includes a simple S.C.R. scaler in which a graphite filament is the load of a 120-amp S.C.R., and a smaller S.C.R. is used to control the length of time the larger unit is allowed to conduct. The linear timer is a "one-shot" univibrator. Long-time firing pulses can be applied to the switch as well as the shorter pulses from the linear timer. (D.L.C.)

30483 (IDO-17042(p.48-63)) INSTRUMENT DEVELOPMENT. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.).

Studies are carried out of: strain gage responses to dynamic pressure surges produced by exploding wires at 400 to 5000 psi; transient in-pile radiation effects on electrical cables and transducers; performance of strain gages on Spert I oxide-core fuel pin cladding; measurement of β/l for ATRC, Spert III, ARMF I, and PBF by noise analysis; an analog Xe simulator whose purpose is to solve the equations governing formation, decay, and burnup of ^{135}Xe and ^{135}I in reactors; and the design of a binary digit amplifier for the ARMF Shaft Angle Encoder. (T.F.H.)

30484 (INR-587/II) UNIVERSAL'NYI RENTGENOVSKII GONIOMETR DLYA ORIENTIROVKI MONOKRISTALLOV. (Universal X-Ray Goniometer for Orientation of Single Crystals). S. Bednarski, K. Skochek, and S. Sharras (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1964. 9p. Dep.

An x ray goniometer for orientation of single crystals by means of the back reflection Laue method is described. Using the goniometer it is possible to study each point of the surface of very long single crystals without moving the sample in the holder. The goniometer is designed for the x ray study of very large single crystals. Sufficiently large shifts as well as interchangeable holders make it possible to study small samples of several millimeters size. (auth)

30485 (ISS-64/43) REPARTO DI MICROSCOPIA ELETTRONICA. RICETTARIO AD USO DEI TECNICI ADDETTI ALLA MICROSCOPIA ELETTRONICA. I. (Department of Electron Microscopy — Manual for Electron Microscopy Technicians. [Part] I). (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Nov. 27, 1964. 72p. Dep. (mn)

Techniques for using electron microscopes are described. Instructions for using the various apparatus are also included. (P.C.H.)

30486 (ISS-64/44) REPARTO DI MICROSCOPIA ELETTRONICA. RICETTARIO AD USO DEI TECNICI ADDETTI ALLA MICROSCOPIA ELETTRONICA. II. (Department of Electron Microscopy — Manual for Electron Microscopy Technicians. [Part] II). (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Nov. 27, 1964. 64p. Dep.(mn)

Techniques for using electron microscopes are described. Instructions for using the various apparatus are also included. (P.C.H.)

30487 (NASA-CR-54247) DEVELOPMENT OF ELECTRICAL SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS. Final Report—Phase I, July 16, 1963—October 16, 1964. E. F. Travis (General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section). Contract NAS 3-2546. 139p.

Theoretical investigations on interruption techniques versus environment, vacuum interrupters, selection of contact material and a-c interruption are presented. The results of Mo and W contact welding tests and high power interruption tests are presented and discussed. Conceptual designs for a-c circuit breaker, d-c engine contactor, and main d-c breaker are described. Prototype switchgear development plans are discussed, and the results of studies on the radiation effects on materials and gases contained in electric switchgear applicable to space nuclear power systems are presented in the Appendix. (L.B.S.)

30488 (RT/EL(65-1)) TRASLATORE CON MEMORIA TAMPONE PER IL TRATTAMENTO DEI DATI IN ESPERIENZE DI FISICA NUCLEARE. (Translator With Core Memory For the Treatment of Data In Nuclear Physics Experiments). E. de Agostino and A. Sano (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan. 1965. 21p. Dep.(mn).

A system for automatic transmission of data from several detection units to one recording device is described. The system, used for data recording from photographs analysis of nuclear events, contains a ferrite-core intermediate memory. (auth)

30489 (SC-DC-65-1237) MEASUREMENTS OF HIGH TEMPERATURES. J. A. Barber (Sandia Corp., Albuquerque, N. Mex.). [1965]. Contract AT(29-1)-789. 30p. (CONF-650204-7). Dep.(mn); $2.00(cy), 1(mn) CFSTI.

From Meeting on Thermocouple Technology and the Effects of Nuclear Radiation on Thermocouples, Washington, D. C.

An analysis is presented of various temperature-sensing devices for use in solids, hydrocarbon-fuel fires, liquid and solid rocket-fuel fires, and rocket nozzles at temperatures up to 6000°F. The devices studied include base-metal and refractory-metal thermocouples, pyrometers, calorimeters, and ceramic and metallic melt sensors. (T.F.H.)

30490 (SC-TM-65-84) A LOW-NOISE, LOW-FREQUENCY AMPLIFIER. D. L. Caskey (Sandia Corp., Albuquerque, N. Mex.). Feb. 1965. Contract AT(29-1)-789. 5p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A low-noise, low-frequency amplifier is described. The amplifier has a gain of 500 over the frequency range 0.2 cps to 10 kc, while the noise voltage referred to the input is approximately 15 microvolts. The unit operates in a temperature environment of −25 to +125°F. (auth)

30491 (UCRL-7816) THE MEANING AND THE USE OF PHOTOMETRIC TERMS. George A Condas (Lawrence Radiation Lab., Univ. of California, Livermore). May 20, 1964. Contract W-7405-eng-48. 50p. Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

A simple, comprehensive, and objective discussion of photometry and photometric terms is given. All of the common photometric units and also some of the rarer ones are discussed. Arguments are given for abolishing certain photometric terms on the basis of eliminating confusion. Many of the discrepancies found in the literature, past and modern, are discussed and rectified. A simple and sufficiently accurate mathematical expression is also proposed for the relative luminous efficiency of radiation. Numerous tables, equations, and applications, all as up to date as possible, are presented to enable the reader to use and understand photometry, its units, and its applications. (auth)

30492 (UCRL-7894) PORTABLE BATTERY-OPERATED HIGH-VOLUME AIR SAMPLER. C. L. Lindeken and R. D. Taylor (Lawrence Radiation Lab., Univ. of California, Livermore). June 10, 1964. Contract W-7405-eng-48. 13p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A portable, 32-pound battery-operated air sampler having a flow capacity of 10 cfm was assembled. The unit consists of a 24-v d-c Staplex Hi-Volume sampler powered by lightweight, 12-v, 12-A-hr rechargeable storage batteries. Battery discharge during a sampling period of 30 minutes results in a reduction in flow rate of about 11%. Wet batteries have been repeatedly recharged without damage. Portability and its self-contained features appear to make it useful for short-duration sampling in areas where a-c power is not readily available. (auth)

30493 (AEC-tr-6559) X-RAY CHAMBER FOR USE TO 2500°C WITH A DIFFRACTOMETER. A. G. Boganov, L. P. Makarov, and V. S. Rudenko. Translated by J. F. White from Dokl. Akad. Nauk SSSR, 161: 332-5(1965). 9p. Dep.(mn); $1.00(cy), 1(mn) CFSTI; $1.10(fs), $0.80(mf) JCL.

A high-temperature vacuum x-ray chamber is described. A wire screen is used to keep the sample in flat form even at the highest temperatures. The sample is heated to 2000°C by a W radiation heater, and above 2000°C by a focused electron beam. The means of connecting the chamber to the diffusion pump is also described. The vacuum obtainable at 2500°C is 5 to 1×10^{-6} mm Hg. Typical x-ray diffraction patterns are given for cubic ZrO_2 at 2300°C and for tetragonal HfO_2 at 2400°C. (D.L.C.)

30494 CONTRIBUTION TO THE DETERMINATION OF THE MEASUREMENT SENSITIVITY IN THE PARTIAL DISCHARGE TESTING OF HIGH VOLTAGE DEVICES. Werner Widmann. A E G Mitt., 55: 28-39(1965). (In German)

As a supplementary method for the testing of the quality of insulation, measurements on the establishment of a very weak partial discharge were carried out. It is, however, very difficult to draw conclusions on the actual intensity of the discharge since the relation between these two parameters is very complicated. The most essential relations were derived. (tr-auth)

30495 LIGHTNING COUNTERS. II. THE EFFECT OF CHANGES OF ELECTRIC FIELD ON COUNTER CIRCUITS. Mueller-Hillebrand, D. (Uppsala Univ.). Arkiv Geofysik., 4: 271-92(1963).

An investigation was made into the behavior of lightning counters with different filter circuits and with different sensitivities, both to cloud flashes and to earth flashes. Filter circuits which pass ELF waves (with the minimum triggering field strength at 0.5 to 1 kc/s) diminish, as the triggering voltage rises, cloud flashes more than earth flashes. The percentage number of recorded cloud flashes falls more rapidly than that of the recorded earth flashes, if the voltage required for triggering is raised. Filter circuits with a minimum triggering field strength of 10 v/m at 10 kc/s and with a bandwidth of 6.7 to 19 kc/s, suppressed about 95% of the cloud discharges, but pass through only about one-third of the pulses originating from earth flashes up to a distance of 15 km, for recording. This means that the number of the earth flashes recorded is about 7 times greater than that of the cloud flashes recorded. But when there are 4 times more cloud flashes than earth flashes, the proportion of cloud flashes recorded in the total number recorded is considerable. Lightning counters with a triode as the triggering element are sensitive only to field changes in the polarity, which occurs in the case of earth flashes in 98% of cases. A lightning counter with the minimum triggering field strength of 5 v/m at 0.5 kc/s recorded 24.7% of 3328 cloud flashes, and 68.1% of 955 earth flashes in thunderstorms at a distance generally up to 12 km, and rarely 15 km. On the whole, 66% of the number recorded were earth flashes, when there were about 3.5 times more cloud flashes than earth flashes, and 77% when there were 2.2 times more cloud flashes than earth flashes. If a simultaneous investigation is made with two lightning counters, the sensitivity of which is 1 : 2 or 1 : 3, then the effective range of the lightning counter can be determined, if the mean triggering distance of the thunderstorm from the lightning counter is known. The investigations were carried out by means of a log-normal distribution of the triggering distances, and the result obtained was that the triode lightning counter with a minimum field strength of 5 v/m has an effective range of about 11 to 12.5 km. The investigation of a lightning counter recommended by the CCIR, with a wide-band filter and a triggering field strength of 3 v/m at 10 kc/s led to results which did not agree with those obtained by Horner. In the case of thunderstorms in Sweden in 1961 and 1962, it did not prove possible to find any correlation between the daily or hourly number of recordings and the local thunderstorms. In the near zone the CCIR counter records a high percentage of cloud flashes, but not in the distant zone. Therefore, the effective range in the zone close to the thunderstorm, which was determined by Horner as 30 km, is different from that in the distant zone, where it is considerably greater. With the 3 v/m sensitivity the effective range was determined to be about 100 to 120 km and 35 to 45 km with 10 v/m sensitivity. (auth)

30496 NUCLEAR INSTRUMENTATION. NO. 22. Bull. Inform. Sci. Tech. (Paris), No. 88, Suppl., 1-43(Nov. 1964). (In French)

The design and specifications of the detectors, power supply, amplifiers, standardized functional elements, counting devices, and radiation detection instruments recently developed by the CEA are summarized. The devices reported include a proportional counter with uniform response, stabilized power supplies for electromagnets, a threshold proportional amplifier, functional elements of fast electronics, an amplitude analyzer, a command chassis for automatic impression, an analog numerical recorder, polyradiameters, an automatic filter analyzer, a random pulse generator, and a pulse generator composed of functional elements. (J.S.R.)

30497 CALIBRATING NUCLEAR GAGES FOR SLURRY DENSITY. R. A. Denning (Army Corps of Engineers). Control Eng., 12: 79-8?(Feb. 1965).

To measure density successfully, the installation and initial calibration of the meter require special attention. The attenuation in radiation energy between source and detector depends on the initial energy of the γ photons emitted by the source and on the number of atomic electrons these photons collide with. How many electronic collisions occur depends on the number of atoms in the path of the photons, which is proportional to both density and thickness of the absorbing material, and the number of electrons per atom, or at. no. of the absorbing mate-

rial. The basic attenuation equation is $I_0/I = e^{\mu x}$ where I_0 is the source intensity, I the radiation intensity in the detector chamber, μ the linear absorption coefficient of the absorbing material, and x the length of the radiation path, or beam length. The ratio I_0/I is the attenuation factor. The linear coefficient of absorption for a water slurry can be taken as equal to the product of the sp gravity S of the slurry and the absorption coefficient for water at the γ energy level involved. With ^{137}Cs as a source (0.661 Mev) the absorption coefficient for water is about 0.123 $in.^{-1}$, and with ^{60}Co (1.17 and 1.33 Mev), it is about 0.0866 $in.^{-1}$. Substituting MS for μ in the above equation, and adding factors b and p, the attenuation equation becomes $I = I_0\, e^{-MS(x-b)-p}$ where M is the absorption coefficient for water at the given energy level, $(in.^{-1})$, S is the sp gravity of the mixture, and x is the beam length (in.). The factor b is an additional correction for the energy buildup. For ^{137}Cs, M is 0.123 and b is 3.2. For ^{60}Co, M is 0.0866 and b is 3.4. The factor p corrects for radiation absorption by the pipe, detector walls, and source holder, but it cancels out of the calibration calculations. Information is also provided for calculating a readout scale, estimating source requirements, compensating for decline of activity of the source, and installation precautions. (TCO)

30498 APPLICATIONS OF INFORMATION STORAGE IN MAGNETIC MEMORIES. D. M. Bernstein. Electron. Eng., 37: 398-400(June 1965).

The storage of data in ferrite core memories is found to have applications other than those of nuclear physics measurements. Various new applications of multichannel memory blocks are indicated. (M.O.W.)

30499 ISOTOPIC METHOD FOR THE DETERMINATION OF DENSITY IN COMPRESSIBLE SYSTEMS. Grafton D. Chase and William H. Parsons (Philadelphia Coll. of Pharmacy and Science). J. Pharm. Sci., 54: 528-30(Apr. 1965).

A method is described in which ^{170}Tm, which emits a γ ray in the energy region of 0.085 Mev, is used as a sealed source to determine the densities of compressible systems when a pulse-height analyzer is employed. Either relative or absolute values of density may be calculated that are considered to be more precise than those obtained by other methods, since the radioisotopic method requires a minimum of disturbance of the system. Theoretical aspects of the technique and construction of the sealed source are outlined. The source holder consists of a Nylon cylinder to receive the radioactive source, the hole being threaded to receive a Nylon bolt. The source volume within the container is ~25 μl. A 0.25-in. cylindrical lead shield is friction-fitted to the source holder. The ^{170}Tm is sealed into the holder by inserting the Nylon bolt, and as a precaution against possible leakage, several coats of acrylic lacquer constitute an external seal. To determine the density of a compressible system, the source is inserted into the sample container. Counts are made at different locations within the container and densities calculated from calibration data; for systems whose densities are either higher or lower than those of the standard solutions, it is necessary to change standards and recalibrate the system. A series of 24 determinations of the densities of oil-in-water type emulsion creams were made at different stages during manufacture and packaging. Data were obtained that are considered more reliable and significant than those obtained by other methods, since it is not necessary to disturb the cream matrix when measuring density by this method. Repeated measurements and their mathematical analysis indicate that density data obtained by this method are significant to three figures and are reproducible readily at this level. (BBB)

30500 OPTIMUM ANALYZER DESIGNS FOR A RADIO-FREQUENCY MASS SPECTROMETER WITH TWO AND THREE DRIFT SPACES. M. Ya. Shcherbakova. Kosmich. Issled., 3: 309-14(Mar.-Apr. 1965). (In Russian)

Numerical methods (with the aid of an electronic computer) were used to investigate relations obtained previously for conversion of ion energy in the analyzer of an r-f mass spectrometer with two and three drift spaces; the optimum relations for the drift lengths were found. Analyzer-design variants recommended for practical use are given. (tr-auth)

30501 ON A TEST OF CONTROL OF SHORT TIME-PHOTOMULTIPLIERS SKP-1. S. V. Muchin, H.-J. Pohl, S. V. Richwizkii, I. N. Semenyuskin, and I. Foltin (Vereinigtes Institut fur Kernforschung, Dubna, USSR). Nucl. Instr. Methods, 33: 339-40(Mar. 1965). (In German)

The control system of the SKP-1 photomultiplier, consisting of two control grids arranged concentrically on the photocathode surface, is described. The coincidence pulse of the photomultiplier and the synchronization device was determined as a function of the phase displacement of u-h-f control voltage. The results show that the experimental results depend to a slight degree on the amplitude of the control voltage. The results do not depend on which control electrode was given the control voltage. The width of the coincidence curve at 0.1% of the maximum counting rate was 4.4 nsec. (J.S.R.)

30502 A FAST, SOLID STATE, PULSE AMPLITUDE DIVIDER AND MULTIPLIER. J. Grunberg, U. Sold, and U. Galil (Soreq Research Establishment, Yavne, Israel). Nucl. Instr. Methods, 34: 311-19(June 1965).

The pulse amplitude divider and multiplier described uses as the main element the Field Effect-Transistor (FET) working in the region before the pinch-off voltage. The integral linearity of the divider, with input changes of 1 : 20 and 1 : 10 respectively at the two inputs (1 : 200 ratio), is better than ±1.5% with a minimum pulse width of 2.5 μs. For the multiplier, the integral linearity for input changes of 1 : 20 at both inputs (output ratio 1 : 400) is better than ±1% with a minimum pulse width of 0.5 μs. The circuits are analog and with slight changes the pulse mode can be converted to a mode for continuous waveform. (auth)

30503 CHARACTERISTICS OF VERY HIGH CURRENT CAPACITY SUPERCONDUCTING SWITCHES. P. W. Nield and O. K. Mawardi (Case Inst. of Tech., Cleveland). Proc. IEEE (Inst. Elec. Electron. Engrs.), 53: 523(May 1965).

An investigation of the performance of superconducting switches with a coaxial configuration (the outer conductor is the superconducting element) is summarized. The results are in reasonable agreement with Silsbee's formula for the maximum capacity of the switch. This agreement indicates the possibility of constructing switches with a capacity an order of magnitude larger (10^5 amp) and with comparable time constants (μsec). (D.C.W.)

30504 ELECTROLYTE LEVEL INDICATOR FOR FLUORINE CELLS (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). 4 drawings. (CAPE-1247)

The level control helps in maintaining optimum electrolyte concentration and a sufficiently high electrolyte level to avoid explosive recombination of H and F in F cells. Since a 1% change in HF concentration is reflected in a ½ in. change in electrolyte level, the HF feed can be effectively controlled by a level measuring device. The indicator consists of a heated thermocouple probe located inside a Monel well with a heating block and heater. The Monel well is extended through the cell cover to a depth of 5 in. which has been found to be the optimum electrolyte level. In operation, a continuous electric current of 115 v is applied to the heater, with a transfer of heat through the heating block and to the bottom of the well. When the well is above the level of the electrolyte, heat transfer through the H atmosphere will result in a temperature of 540°F. The thermocouple transfers a temperature impulse to a potentiometer-controller which, in turn, opens a solenoid-actuated valve on the HF supply. When sufficient HF has been fed, there is a temperature drop and the feed valve closes. The electrolyte level may be controlled in a range of ±0.25 in. and HF concentration within 0.5%. Drawings (4) are included. (P.C.H.)

30505 IMPROVEMENTS IN OR RELATING TO VACUUM LOCKS FOR MASS SPECTROMETERS. Albert Hickford Turnbull, Frederick Hart, and Donald John Michael Drew (to United Kingdom Atomic Energy Authority). British Patent 987,217. Mar. 24, 1965. Filed Nov. 4, 1960.

A vacuum lock for a mass spectrometer in which a sealing element is moved into a vacuum sealing position includes a fixed orifice member, a relatively movable member, and a magazine for holding a plurality of sealing elements. Means also are provided for moving an individual sealing element from the magazine in to register with an orifice in the fixed member. The movable member abuts and clamps an element against the fixed member to seal the orifice. Preferably the movable member is urged into abutment by fluid pressure, and a positive seal is provided between the movable member and a vacuum retaining portion of the lock. The sealing element may have the form of a sphere or a flat disc. The lock is particularly applicable for isolating the source region of a spectrometer from the rest of the instrument. (B.L.M.)

30506 DIRECTIONAL THERMAL RADIATION INTENSITY DETECTOR. John R. Cunningham, Don Mills, and James A. Carruthers (to Minister of National Defence). Canadian Patent 680,635. Feb. 25, 1964. Filed Feb. 14, 1961.

A low cost device described for generally indicating the direction and radiant energy of a source of thermal radiation is made up of a body formed of a thermo-sensitive material having a surface exposable to the radiation. Means are provided for substantially shielding the surface from thermal radiation with an aperture of predetermined size in the shield. The aperture is fixed in relation to the surface and is so located that at least a portion of the thermal radiation emanating from a source contained in a predetermined solid angle extending from the aperture will impinge on the surface and cause an indention to be burned in the surface. The depth of the indention is proportional to the radiant energy per unit area and the location of the indention in relationship to the aperture indicates the direction of the source. Commercially available polystyrene coated with colloidal graphite suspended in an alcohol is a suitable material for the device. (B.L.M.)

30507 LINEAR GATE WITH GATING PULSES APPLIED TO COLLECTOR THROUGH THE PRIMARY OF A TRANSFORMER. J. Fisher, W. A. Higinbotham, and R. L. Chase (to U. S. Atomic Energy Commission). U. S. Patent 3,182,208. May 4, 1965.

A fast-acting linear gate circuit is designed for handling the signals from radiation detectors to give information in the locations of specific ionizations and an indication of one or two simultaneous particles traversing a hodoscope. A transistor normally at or below cutoff is provided having an emitter at ground, and the input signal is applied to the transistor base in a direction to turn on current through the transistor while the collector is connected through a transformer winding to load. In the absence of a gating signal on the transformer primary, there is no collector potential for the transistor and no transistor signal to load. In the presence of the gating signal, the transistor has a very fast response and provides a signal in the load linearly corresponding to the input signal. (AEC)

30508 PHOTOMULTIPLIER. Roderick J. Grader and Minoru Paul Nakada (to U. S. Atomic Energy Commission). U. S. Patent 3,183,390. June 11, 1965.

An electron multiplier tube featuring a succession of electrodes of cylindrical geometry was designed. An outwardly-facing frusto-conical electrode surrounded by an inwardly-facing frusto-conical electrode, both diverging in the same axial direction, represents a module; the module is serially repeated in mirror-image succession along the axis to comprise the principal electrode array. Reported advantages include reductions in electron losses and amounts of focussing apparatus required. (AEC)

30509 HIGH-DUTY-CYCLE MULTIVIBRATOR. Duane O. Hale (to U. S. Atomic Energy Commission). U. S. Patent 3,184,604. May 18, 1965.

A monostable multivibrator circuit was developed, which utilizes transistors and has a minimum recovery time so that the circuit can respond to an incoming trigger pulse immediately after responding to a previous pulse. The customary multivibrator dead time is thus greatly reduced in magnitude. To effect this result the circuit includes the usual multivibrator resistance-capacitance network and includes means by which the resistance is shunted during the discharge portion of the cycle. It is desirable that the discharge occur as rapidly as possible to minimize the dead time. (AEC)

30510 VARIABLE TIME CONSTANT PULSE INTEGRATOR. G. W. Rodgers (to U. S. Atomic Energy Commission). U. S. Patent 3,189,833. June 15, 1965.

A pulse integrator capable of providing a readily variable pulse integration time and an effective integration time greater than the physical resistance-capacitance time constant by a calculable gain factor is described. The circuit comprises a resistance-capacitance pulse stretching network in combination with a resistance-capacitance pulse integrating network having a triode tube or equivalent introducing power gain into the circuit. The physical integration time constant is multiplied by a positive feedback while the circuit is rendered stable by inclusion of negative feedback. (AEC)

30511 SCANNING ELECTRON MICROSCOPE. Albert V. Crewe (to U. S. Atomic Energy Commission). U. S. Patent 3,191,028. June 22, 1965.

A new type of scanning electron microscope is described. The microscope comprises a point source of monoenergetic electrons with means for focusing the electrons into a spot on a specimen. Means are provided for raster scanning the focused electron spot over the specimen and a momentum analyzer is adapted to separate electrons transmitted through the specimen into discrete energy levels. A scintillation detector is positioned to detect the separated electrons at a discrete energy level thereof and a cathode ray tube, having the X and Y sweeps thereof synchronized with the raster sweep scan of the electron spot, is connected to the detector so that the display intensity of the cathode ray tube is responsive to the output of the detector. (AEC)

Radiation Detection

Refer also to abstracts 29874, 30104, 30453, 30477, 31080, 31087, 31089, 31245, 31267, 31316, 31459, and 31460.

30512 (AECL-2219) A CONTROL AND READ-OUT SYSTEM FOR THE CHALK RIVER DOUBLE CRYSTAL γ-SPECTROMETER. W. D. Howell and W. R. J. Shorey (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Apr. 1965. 107p. Dep.; $1.00(AECL).

The Chalk River Double Crystal γ Spectrometer designed for precision measurement of gamma ray energies requirements has, as part of its automatic positioning system, a control unit to program the direction and running time of three motors. Two of these motors control the rotation of the two diffracting crystals and the third controls the angular measuring device which tracks the movement of the crystals. The motors are operated in incremental steps which are measured by microswitches riding on the teeth of spur gears in the drive mechanism. On completion of a required spectrometer increment a counting operation is performed on the gamma beam for a preselected time. The read-out system then records the accumulated data on a Brown recorder, an IBM typewriter and, if desired, on a tape punch in either IBM (8 hole) or Datatron (7 hole) code. The spectrometer is programmed to scan back and forth across a gamma line, reading the data as it proceeds. The spectrometer motor control system and the operating instructions for the associated General Purpose read-out system are described. (auth)

30513 (AEET/TP/4) PREPARATION OF EUROPIUM ACTIVATED LITHIUM IODIDE SCINTILLATION CRYSTALS. K. K. Devgan (Atomic Energy Establishment, Trombay (India). Technical Physics Div.) 1964. 11p. Dep.(mn).

Europium-activated lithium iodide LiI(Eu) single crystal is an efficient detector for slow neutrons. Details of the process developed for the preparation of anhydrous lithium

iodide and its subsequent growth into large single crystals are presented and their response to slow neutrons is shown. Satisfactory performance has been observed with the crystals. (auth)

30514 (AERE-M-1574) DISPENSING SOLUTIONS FOR LIQUID SCINTILLATION COUNTING. Horace E. Dobbs (Research Group, United Kingdom Atomic Energy Authority, Wantage (England)). Apr. 1965. 9p. Dep.; $0.30(BIS), 1s. 9d. (HMSO).

The dispensing of radioactive solutions into phials containing liquid scintillator often results in errors due to vapor losses. Four syringe techniques were investigated for dispensing radioactive volatile and nonvolatile organic liquids. The accuracy of the results is compared. (D.L.C.)

30515 (BDX-613-71) A SLOW TIME BASE READOUT SYSTEM FOR NON-REPETITIVE PULSE ANALYSIS. Carl E. Thomson (Bendix Corp., Kansas City, Mo.). May 1965. Contract [AT(29-1)-613]. 91p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

A system is developed to effectively stretch a single, fast pulse waveform (with microsecond duration) to a slow time base (with pulse waveform of several seconds' duration). Time base expansion of a fast nonrepetitive pulse is accomplished by storing voltage amplitudes sampled at several points along the pulse duration. A description is given of composite circuit operation and individual circuit requirements. Details of theory and design principles are discussed. Experimental results and design modifications evolving from experimental evaluation are presented. (M.J.T.)

30516 (CERN-65-15) RECONSTITUTION DE TRACES RECTILIGNES DANS UNE CHAMBRE A ETINCELLES A ELECTRODES TRANSPARENTES. (Reconstitution of Rectilinear Tracks in a Spark Chamber with Transparent Electrodes). V. Chabaud and F. Plouin (European Organization for Nuclear Research, Geneva (Switzerland)). Apr. 22, 1965. 50p. Dep.(mn).

The advantages of spark chambers using transparent electrodes, enabling tracks to be photographed from the ends of the chamber through the electrodes, are discussed. A brief review of projective geometry and of the projective properties of the photographic objective is given. The necessity of numbering the images of sparks is discussed, and it is shown that, under certain conditions, a rectilinear track can be reconstructed in space with photographs taken from a single point of view. Two methods of reconstruction—geometric and analytic—not requiring the knowledge of the position of the camera are described, and an example of the actual application of the methods is given. (M.J.T.)

30517 (CERN-65-21) THE ELECTRONIC LOGIC SYSTEM USED WITH THE MAGNETIC SPARK CHAMBER. W. Beusch (European Organization for Nuclear Research, Geneva (Switzerland)). May 31, 1965. 31p. Dep.(mn).

A description is given of the main features of the electronics used in the experiments with the magnetic spark chamber. The electronics include a discriminator for photomultiplier pulses, a fivefold coincidence unit, a fan-in circuit, a fan-out, and a limiter for photomultiplier pulses. The performance in an experiment is described. (D.L.C.)

30518 (CLOR/GUM-35) WPLYW ZMIAN WIDMA PROMIENIOWANIA X NA GESTOSC OPTCZNA EMULSJI FOTOGRAFICZNEJ PRZY STALEJ PIERWSZEJ WARSTWIE POLCHLONNEJ. (Effects of X-Ray Spectrum Variations on the Optical Density in Photographic Emulsion, By Constant HVL). T. Musialowicz, Z. Referowski, J. Wysopolski, and A. Zdrojewska (Centralne Laboratorium Ochrony Radiologicznej, Warsaw (Poland)). 1964. 20p. Dep.(mn)CFSTI.

Results of an investigation of the relation between optical density in dosimetric films "Foton" and x-ray tube potential are reported and discussed. Eight values of constant effective energy (HVL = const) in the range 32 to 150 kev were selected for irradiation of films with constant exposure 300 mR. Below 100 kv the character of density variations was irregular. Above 100 kv, the optical density decreased with the increase of effective energy. By constant effective energy 115 kev the optical density for 200 kv was by 15% higher than the corresponding value for 150 kv. (auth)

30519 (CLOR/IBJ-II-36/D) MULTI-GUARD-RING GOLD–SILICON SURFACE-BARRIER DETECTORS. J. Roman, A. Dabrowski, S. Glowacki, M. Jagusztyn, M. Slapa, and J. Chwaszczewska (Centralne Laboratorium Ochrony Radiologiczej, Warsaw (Poland)). 1965. 11p. Dep.

Gold-silicon surface-barrier beta spectrometers with multi-guard-rings (3000-5000 ohm-cm n-type silicon) have been made. The devices have proved to be very stable in long-term operation and to withstand at room temperature a reverse bias greater than 1500 volts. The reverse current passing through the signal electrode and the guard-rings was less than 1 μamp at 1000 volts bias. The beta particles and internal-conversion electrons energy spectra have been measured. The energy resolution at room temperature was of about 9 kev (f.w.h.m.) for 625 kev electrons. (auth)

30520 (IDO-17017) THE CALCULATION OF GAMMA-RAY SHAPES FOR SODIUM IODIDE SCINTILLATION SPECTROMETERS. COMPUTER PROGRAMS AND EXPERIMENTAL PROBLEMS. R. L. Heath, R. G. Helmer, L. A. Schmittroth, and G. A. Cazier (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1965. Contract AT(10-1)-205. 166p. Dep.; $5.00(cy), 3(mn) CFSTI.

A method is described for the calculation of pulse-height distributions which represent the response of a NaI scintillation spectrometer to monoenergetic photons. The method is based upon an interpolation between experimental spectra for sources emitting only one gamma ray. A detailed description of the experimental procedures used to accumulate input data is given. This discussion includes the analysis of photopeak shapes, detector efficiency, nonlinear relationship between energy and pulse-height for NaI, and a general consideration of problems incidental to the analysis of gamma spectra. The interpolation method is described, and the computer program devised to carry out this procedure is outlined in considerable detail. The resulting calculated gamma shapes are compared with the input shapes and other simple spectra. Examples of the use of calculated gamma shapes for the analysis of complex spectra are presented. The computer programs described are written in FORTRAN IV for use on an IBM-7040 computer. The complete program listings are included together with flow charts. Listings of sample input to and output from the programs are given. In addition, computer programs are briefly described which are designed to gain-shift spectra, to fit modified-gaussian functions to photopeaks, to calculate coincidence sum spectra, and to do least-squares fits to complex spectra with calculated gamma shapes and other components. (auth)

30521 (INR-592/11/PL) POLUCHENIE GERMANIEVYKH SPEKTROMETROV γ IZLUCHENIYA PO METODU DREIFA IONOV LITIYA. (Preparation of Germanium γ Spectrometers by Lithium-Drift Method). M. Dakovski, V. Pshiborski, M. Sventchak, M. Sovinski, and Ya. Khvashchevska (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1964. 13p. Dep.

Germanium diodes for γ-ray spectrometry using the lithium-ion drift technique and p-type germanium have been fabricated. Active depths up to 1.5 mm were obtained. The γ-spectrum of source radioactive elements using these detectors (working at 90°K) are presented. The resolution for ^{181}Hf(γ-energy of 615 kev) is 7.2 kev and for ^{60}Co(γ-line of 1333 kev) is 12 kev. (auth)

30522 (IS-1159) METHOD FOR MEASURING INTERNAL CONVERSION COEFFICIENTS USING A BENT-CRYSTAL GAMMA-RAY MONOCHROMATOR AND A MAGNETIC ELECTRON SPECTROMETER. E. N. Hatch, G. W. Eakins, G. C. Nelson, and R. E. McAdams (Ames Lab., Iowa State Univ. of Science and Tech.). May 13, 1965.

Contract W-7405-eng-42. 7p. (CONF-650525-1). Dep. (mn); $1.00(cy), 1(mn) CFSTI.

From International Conference on the Internal Conversion Process, Nashville.

A direct method for experimentally determining internal conversion coefficients has been studied with the hope of achieving accuracy of 5% or better for many nuclear transitions of interest. In this method the relative intensities of internal conversion lines from a radioactive source are determined with a magnetic electron spectrometer. The relative intensities of the gamma rays from the same source are then determined by a least-squares analysis of the NaI pulse-height spectrum using monochromatic response functions obtained with a bent-crystal gamma-ray diffraction monochromator. Relative internal conversion coefficients are then obtained by taking the ratio of the conversion line intensities to the relative gamma intensities. In order to normalize the relative internal conversion coefficients, a ^{123m}Te source is mixed with the source to be measured, and the experimentally measured ^{123}Te 159-kev internal conversion coefficient is used for the normalization standard. To illustrate this method, internal conversion coefficients of the ^{170}Yb 84-kev transition have been determined. (auth)

30523 (JINR-P-1997) METODY PREOBRAZOVANIYA VREMENI V AMPLITUDU V NANOSEKUNDNOM DIAPAZONE (OBZOR). (Methods of Transformation of Time into Amplitude in Nanosecond Range (Review Paper)). N. M. Drazhev (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1965. 35p. Dep.(mn).

Present methods for transformation of time into amplitude in the nanosecond range are given. The main parameters of the apparatus are generalized and analyzed. Material in the literature to about the middle of 1964 is included. 114 references. (auth)

30524 (NP-14972) NON-DESTRUCTIVE METHOD OF U235 BURN-UP INVESTIGATION BY USE OF THE COBALT MONITORS INTEGRATING THE NEUTRON FLUX DURING THE TIME. FINAL REPORT — TEXT. Jerzy Aleksandrowicz (Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research). Dec. 1961. 108p. Dep.(mn).

Includes Final Report–Daily Reports.

A method for determining ^{235}U burnup in VVR-S reactors is described, utilizing Co-loaded Al flux wires to monitor the total neutron flux distribution along the fuel elements. Raw data are tabulated and graphed, and the techniques used in their reduction are noted. (T.F.H.)

30525 (NYO-3421-3) PHOTOMULTIPLIER INVESTIGATION. Summary Report, June 15, 1964–March 14, 1965. H. M. Smith, Jr., and R. Wasserman (David Sarnoff Research Center, Princeton, N. J.). Apr. 14, 1965. Contract AT(30-1)-3421. 43p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Two problems often encountered are those of dark pulses and gain shift with count-rate or short-term stability. Investigations have been made on the causes of these problems. With regard to the dark current problem, many tubes have been studied and some of their similarities and differences are analyzed. All tubes examined appear to exhibit three types of dark pulses, namely, thermionic electron pulses, non-thermionic "single" electron pulses, and non-thermionic "multi-electron" pulses. These three types have been studied with respect to a wide range of tube parameters. Appropriate instrumentation has been developed for the study of the stability problem. A survey of the pulse height shift in a number of commercial tubes is now underway. (auth)

30526 (ORNL-P-1089) ABSOLUTE ENERGY CALIBRATION OF SOLID-STATE DETECTORS FOR FISSION FRAGMENTS AND HEAVY IONS. H. W. Schmitt, W. M. Gibson, J. H. Neiler, F. J. Walter, and T. D. Thomas (Oak Ridge National Lab., Tenn.). [1965]. Contract [W-7405-eng-26]. 19p. (CONF-650301-11). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Symposium on the Physics and Chemistry of Fission, Salzburg, Austria.

The response of silicon semiconductor detectors to ^{252}Cf, ^{235}U, and ^{239}Pu fission fragments and to monoenergetic bromine and iodine ions was studied to obtain information from which precise particle energies can be obtained from pulse-height measurements. Measurements were made for surface-barrier and diffused junction detectors of widely varying resistivities with different window thickness and diffusion depth and for a broad range of operating conditions. The experiment is described and the results are analyzed. (L.B.S.)

30527 (ORNL-P-1110) RECENT DEVELOPMENTS IN THE PROTON-RECOIL SCINTILLATION NEUTRON SPECTROMETER. W. R. Burris and V. V. Verbinski (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 38p. (CONF-654-89). Dep.(mn); $2.00(cy), 1(mn) CFSTI.

From American Nuclear Society Meeting, San Francisco, Nov.-Dec. 1964.

Details of the pulse-shape discrimination circuit (for rejecting gamma background) and of the unscrambling code (to resolve the problem of poor line shape) used in a proton-recoil scintillation neutron spectrometer are discussed. Characteristics of the NE-213 and stilbene scintillators and of the pulse-shape discriminator operation are described. The FERDO program for unfolding instrument response is described, including the FERDO viewpoint of inequality constrained estimation, estimation of the statistical confidence region, the minimization scheme, and transformation matrix calculation. A listing of the FORTRAN-IV/FORTRAN-63 programs for FERDO and a subroutine GINV is given. Sample results are shown for pulse-height spectra from the ^{9}Be(α,n)^{12}C reaction at 7.3 and 10.1 Mev and from the beam from the ORNL Tower Shielding Reactor. (M.J.T.)

30528 (RFP-500) AN ANALYZER FOR RADIOACTIVE GAS. R. T. Merrill (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). May 11, 1965. Contract AT(29-1)-1106. 14p. Dep.; $1.00(cy), 1(mn) CFSTI.

An instrument that can continuously monitor air for tritium has been developed. It utilizes a flow type ionization chamber and a vibrating reed electrometer. A response of double normal background is produced by 9.4×10^{-5} μC ^{3}H/cc air; the presently accepted MPC is 2.0×10^{-5} μC ^{3}H/cc air. Its operation is completely automatic. (auth)

30529 (TID-21829) PRELIMINARY RESULTS USING A GERMANIUM LITHIUM-DRIFTED DIODE FOR GAMMA-RAY SPECTROSCOPY. J. J. Reidy (Michigan Univ., Ann Arbor). [nd]. Contract [AT(11-1)-112]. 14p. Dep.(mn), $1.00(cy), 1(mn) CFSTI.

The mounting of the RCA SJGG-1 Li-drifted Ge diode is described, and the electronic arrangement is shown. The diode is used mainly to obtain single spectra of decays which are studied with a curved crystal spectrometer. Possible future use in high-resolution coincidence experiments is discussed. Measured spectra are presented of ^{187}W decay over the range 450 to 900 kev and of ^{198}Au in the region 110 to 430 kev. (M.J.T.)

30530 (UCID-1966 & Suppl.) PEPR AND OTHER SYSTEMS. A. H. Rosenfeld (California Univ., Berkeley); and H. D. Taft (Yale Univ., New Haven, Conn.). 1962. Contract W-7405-eng-48. 58p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Computer programs and machines for analyzing bubble-chamber films are considered. A proposal is presented for programming the Precision Encoder and Pattern Recognition (PEPR) device at MIT. Automatic scanning and measuring systems are reviewed, and means for unifying the output of these systems and processing this output are proposed. (T.F.H.)

30531 (UCRL-11199) A LOW-COST PERSONAL RADIATION MONITOR. Henry S. Dakin (Lawrence Radiation Lab., Univ. of California, Berkeley). May 29, 1964. Contract W-7405-eng-48. 22p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

An inexpensive and highly reliable pocket-sized (1 by 2¼ by 3½ inches) warning device was developed for use by workers around radiation sources. Electric circuitry incorporates some important features made possible by

recent technological advances, including use of low-cost NPN silicon transistors for temperature stability. No specially made or individually selected components are used. Mechanical design features include shock-mounted printed-circuit construction to minimize damage due to dropping and to simplify repairs, and provision for optional addition of a sensitivity-changing switch and external-speaker output, for remote monitoring purposes. Based on the original concept of R. H. Dilworth and C. J. Borkowski of Oak Ridge, this instrument gives an audible indication of approximate gamma-radiation intensity between about 10^{-4} and 1 roentgen per hour by means of scaling or integrating of Geiger-Müller tube pulses, and gives a steady loud tone indication of higher intensities up to above 10^{6} roentgens per hour. Uncalibrated thermal-neutron sensitivity is achieved by use of an optional thin silver foil surrounding the G-M tube. Response to radiation from pulsed radiation sources is limited by the G-M tube's dead time of approximately 20 μsec. Battery life is about 2000 hours. Approach of the end of battery life is indicated by a change in the output signal, although the instrument's calibration is retained throughout the battery's useful life. (auth)

30532 (UCRL-11999) THE USE OF A LARGE PHOTO-DIGITAL MASS STORE FOR BUBBLE CHAMBER ANALYSIS. Margaret H. Alston and Samuel J. Penny (Lawrence Radiation Lab., Univ. of California, Berkeley). May 1965. Contract W-7405-eng-48. 11p. (CONF-650510-2). Dep. (mn); $1.00(cy), 1(mn) CFSTI.

From Purdue Conference on Instrumentation for High Energy Physics, Lafayette, Ind.

The purchase of a photodigital store with a capacity of about 3.3×10^{11} bits is planned. This store, which is a "read only" memory, will be connected online to the CDC-6600 computer and will serve as a repository for many types of information. The data in the store can be accessed directly by programs running in the central computer or by "priority" requests initiated at online consoles. A proposed system for the data manipulation and retrieval required to handle the analysis of over one million bubble chamber events per year is presented. (auth)

30533 (UCRL-16087) REVIEW OF FILM-LESS SPARK CHAMBER TECHNIQUES: ACOUSTIC AND VIDICON. Victor Perez-Mendez (Lawrence Radiation Lab., Univ. of California, Berkeley). May 3, 1965. Contract W-7405-eng-48. 17p. (CONF-650510-3). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Purdue Conference on Instrumentation for High Energy Physics, Lafayette, Ind.

A brief review is presented of acoustic and Vidicon methods for providing direct digitized readouts from spark chambers into storage or computers. The characteristics of each method are described, and some improvements in each are considered. The magnetostrictive readout, a modification of the acoustic method, is discussed in detail. Future applications are considered briefly. (D.L.C.)

30534 (USNRDL-TR-829) A COMPUTER PROGRAM FOR UNFOLDING PULSE-HEIGHT DISTRIBUTIONS. C. V. Smith and N. E. Scofield (Naval Radiological Defense Lab., San Francisco, Calif.). Mar. 5, 1965. 40p.

Three sub-programs used to unfold gamma-ray-scintillation-spectrometer-pulse-height distributions are given. These programs are written in FORTRAN II for an IBM-704 computer with a 4K word core and an 8K word drum storage capacity. Sub-program I performs a bivariate interpolation from the Compton tails of the calibration response spectra to the Compton tails of the desired response matrix, and also adds to these the interpolated "photopeaks" to form the response matrix columns. Sub-program II performs the matrix multiplications necessary to form the weighted least squares vector equation: $\bar{R}\omega C = \bar{R}\omega RN$, where R is the response matrix, $\bar{R}$ is its transpose, ω is a least squares weighting matrix, and C and N are one-column matrices representing the pulse height distribution and gamma-ray energy spectrum, respectively. Sub-program III solves this equation for N by an iterative method which yields a close approximation to the best fitting gamma-ray spectrum. Also included is an unfolding program which is compatible with a 32K core storage computer. The mathematical process used is the same as the above-mentioned process. One main program and two sub-routines are presented. (auth)

30535 (WCAP-2644) MINIATURE NEUTRON DETECTOR DEVELOPMENT. Quarterly Progress Report, April 1–June 30, 1964. J. Weisman, ed. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). July 15, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2827. 17p. (EURAEC-1150). Dep. (mn); $1.00(cy), 1(mn) CFSTI.

Work has continued on the development of silicon carbide diodes for the detection of neutrons under sustained high-temperature, high-flux conditions. A technique was developed for evaporating a thin film of ^{235}U on the surface of the diode. Diodes so processed successfully counted fission fragments produced by exposure to a neutron source. The greatest emphasis during this period has been placed on the preparation of a high temperature mounting for counting diodes. Such a mounting will allow the entire assembly to be repeatedly heated to temperatures up to 1300°C. It is expected that this will allow substantial annealing of irradiation damage. Configurations which successfully withstand this thermal cycling have been developed but units so processed have shown a very poor α counting ability. (auth)

30536 (WCAP-2666) MINIATURE NEUTRON DETECTOR DEVELOPMENT. Final Report. J. Weisman, ed. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Oct. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2827. 85p. (EURAEC-1278). Dep.(mn); $3.00(cy), 2(mn) CFSTI.

This report summarizes the results of the development of miniature silicon carbide neutron detectors carried out from June 1961 to September 1964. The program has developed surface junctions capable of detecting charged particles. The detector diodes are produced by diffusing aluminum into SiC crystals to a predetermined depth. The 3-stage diffusion process used is reproducible and has a good yield of useable diodes. A technique for converting the diodes into neutron detectors by vapor deposition of ^{235}U has been developed. Such diodes have been shown capable of counting thermal neutrons up to 800°C. Radiation damage studies have shown the diodes to have appreciably more radiation resistance than similar silicon diodes. However, the lifetime of present structures within a power reactor is estimated to be only between 100 and 1000 seconds. There is evidence that substantially improved lifetimes can be obtained by annealing the diodes at temperatures above 1000°C. Substantial efforts have been made to develop diode contacts which will withstand these temperatures but these efforts have not been successful. The diodes would appear to have significant utility for flux mapping in high temperature criticals and for some space exploration applications. (auth)

30537 (ZfK-PhA-14) EFFEKTIVITATSBERECHNUNGEN FUR PROPORTION-ALZAHLROHRE. (Efficiency Calculations for Proportional Counters). Karl Hohmuth (Deutsche Akademie der Wissenschaften zu Berlin (East Germany) and Zentralinstitut fur Kernphysik, Rossendorf bei Dresden (East Germany)). Feb. 1964. 21p. Dep.(mn).

The efficiencies of several proportional counters were calculated with the electronic computer ZRA 1 of the Central Institute of Nuclear Research. The results are shown graphically and given in tables. (auth)

30538 RADIATION PROTECTION MEASUREMENTS OF ALPHA-ACTIVE AEROSOLS. Karl Schmidt. Bergakademie, 16: 290(1964). (In German)

The construction of a piece of equipment for detection and measurement of α radioactivity in aerosols is described briefly. The apparatus permits constant monitoring of the average air concentrations without interruption. Significant peaks of concentration or variations in

concentration are shown qualitatively. The rate of inhalation can be estimated for various time intervals from the radioactivity of the integral filter. The air flow is automatically regulated. The type of detectors used are thin sheets of inorganic crystals of CsI(Tl). The equipment also will detect β-active aerosols. Collection of radioactive particles over extended periods of time permits then to be measured more accurately and simply, and the total atmospheric irradiation exposure can be evaluated more easily. The equipment is capable of very accurate detection of atmospheric radioactivity concentrations, and permits the peaks of radioactivity to be averaged out automatically with the lower concentrations detected also. Thus, it makes it more readily possible to compare the average radioactivity concentrations detected with the permissible limits established by the International Commission for Radiation Protection (ICRP). (BBB)

30539 INSTRUMENTAL AND TECHNICAL NOTES. A DEMOUNTABLE PHANTOM OF VARIABLE GEOMETRY FOR INTRA-PELVIC DOSIMETRY IN PREGNANCY—PRELIMINARY REPORT. I. Nikl (Frederic Joliot-Curie National Research Inst., Budapest). Brit. J. Radiol., 38: 472-4(June 1965).

An inhomogeneous, variable, demountable phantom was built to determine the radiographic exposure dose during pregnancy, both to the embryo in various developmental stages and to the maternal genitalia. Measurements were made at several sites on three abdomens and seven fetuses of different sizes for 15 different ovarian positions. All measurements were made with 13 different beam directions that might reasonably occur during pregnancy and with three x-ray qualities (normal x rays with both inherent and added filtration and hard x rays). Uses of the phantom are discussed. (H.G.D.)

30540 STUDY OF THE PYROELECTRIC PROPERTIES OF SOME CRYSTALS AND THEIR UTILIZATION IN THE DETECTION OF RADIATION. Armand Hadni, Yolande Henninger, Robert Thomas, Pierre Vergnat, and Bruno Wyncke (Faculte des Sciences, Nancy). Compt. Rend., 260: 4186-9(Apr. 12, 1965). (In French)

Under certain conditions, the pyroelectric properties of monocrystals are reproducible and can lead to radiation receptors sensitive in all the infrared region, while possessing the original characteristics of admitting fluxes of considerable geometric extent, modulation at frequencies of the order of a kilocycle per second, and ease of production. The detectivity D^* (500°C, 12.5 c/sec, 1 sec) can reach 5×10^8. (tr-auth)

30541 EQUIPMENT FOR MEASURING LOW ACTIVITIES. L. Kuhn. Glas-Instr.-Tech., 8: 59-62(Feb. 1964). (In German)

There are various methods of measuring low levels of radioactivity. Some criteria for the evaluation of low level test benches are collated to enable the user to make a decision in the selection of the most suitable equipment. An equation is given which permits the evaluation of various installations by comparing the measuring time or by comparing statistical probability data and the zero effect. (auth)

30542 THE MEASURING TECHNIQUE WITH LOW-ENERGY BETA EMITTERS. PART I. K.-H. Bremer. Glas-Instr.-Tech., 8: 541-5(Aug. 1964). (In German)

The development of highly sensitive measuring methods for low-energy beta emitters allows the application of these nuclides on a larger scale for research. The most important methods and detectors, such as thin-wall and flow-through counting tubes, scintillation counting in gaseous and liquid phase as well as some special methods are discussed and their advantages and disadvantages are critically compared. (auth)

30543 THE MEASURING TECHNIQUE WITH LOW-ENERGY BETA EMITTERS. PART II. K.-H. Bremer. Glas-Instr.-Tech., 8: 615-19(Aug. 1964). (In German)

Techniques for measuring the activity of low-energy beta emitters, using chromatographic separation processes, are presented. The usual methods using paper and thin-layer chromatography with flow-through counting tubes, end window tubes, and liquid scintillation counters are discussed, along with autoradiographic techniques with nuclear emulsions. An apparatus for the automatic scanning and direct quantitative determination of radio-paper chromatograms is described. Column and gas chromatographic techniques are also discussed. (L.B.S.)

30544 A NEW PERSONNEL MONITOR. K. F. Smith and J. B. Thompson (Phillips Petroleum Co., Idaho Falls, Idaho). Health Phys., 11: 507-17(June 1965).

A new personnel monitor to be used in areas of varying background radiation is described. The instrument was designed to be used in areas where the background changes by a factor of as much as 100. The new monitor operates on a different principle than do the commercial monitors that have been investigated to date. These monitors are dependent on the absolute level of radiation to give an alarm whereas the new monitor is dependent on the abrupt change that occurs when a contaminated person passes a monitor. The new monitor is shown to have a theoretical improvement of approximately two orders of magnitude over systems based on the absolute level when the background varies by a factor of 100 and the source is exposed to the monitor for 1 sec. This monitor is also shown to have approximately one order of magnitude improvement over the absolute level system when the background varies by a factor of 5, a normal variation, provided the source exposure time is extended to 10 sec. A complete personnel portal monitor was built and tested. Results of tests performed on this monitor are shown to be in close agreement with the theoretical performance of the system. (auth)

30545 HIGH γ-DOSE RESPONSE OF RECENT SILVER-ACTIVATED PHOSPHATE GLASSES. K. Becker (Kernforschungsanlage, Julich, Ger.). Health Phys., 11: 523-9 (June 1965).

The 10^{-2}–10^3 R γ-dose range of the YOKOTA-type dosimeter glasses can be extended to about 10^7 R by fluorimetric and/or absorption measurements. The superimposed effects of increase and decrease of fluorescence and absorption center concentration were studied for glasses of different silver concentrations under different conditions (thermal and uv-bleaching, thermal stabilization of effects, etc.). Practical and theoretical aspects of the experiments are discussed briefly. (auth)

30546 ENVIRONMENTAL FACTORS AFFECTING GLASS ROD DOSIMETRY. B. G. Blaylock and J. P. Witherspoon, Jr. (Oak Ridge National Lab., Tenn.). Health Phys., 11: 549-52(June 1965). (ORNL-P-300)

Application of glass-rod dosimetry is increasing in field radiation ecology studies. To qualify certain of these field uses, a study was made on the influence of temperature and sunlight on radiation response (fluorescence) of Toshiba low-Z rods. In a temperature range of 3.5 to 53.5°C, rods showed no change in response to beta radiation from ^{137}Cs solutions. The response to ^{137}Cs gamma rays, however, increased with increasing temperature. A linear expression describing this increase is $Y = 4.32 + 0.014X$, where Y is fluorometer units per rad, and X is temperature (°C). Predosed rods were found to fade (lose fluorescence) exponentially when exposed to sunlight for 30 hr, given in 6-hr increments at about 10^4 ft-c. Rods lost 37 to 46% of the dose during the first 6-hr exposure. Fading was also related to predose, as high-predosed (5515 fluorometer units) rods had a significantly greater ($P < 0.01$) percentage of fading than low-predosed (396 fluorometer units) rods. The effectiveness of several kinds of shields was studied, and nylon plastic shields painted black were found to prevent fading when tested by 24-day exposures on White Oak Lake bed. (auth)

30547 APPLICATIONS OF TYPE 18600 NEUTRON GENERATOR TUBE. PART 2. COUNTING OF NEUTRONS. F. de la Barre. Ingrs. Techniciens, No. 180, 91-6(Oct. 1964). (In French)

The possible applications of the neutron generator tube 18600 are briefly summarized. The methods used for the detection and measurement of neutrons—simple detectors

and regimes of operation of ionization chambers—are outlined. (J.S.R.)

30548 FULLY AUTOMATIC INSTRUMENTS FOR CODING AND READING PERSONNEL RADIATION MONITORING FILMS. Heard, M. J. (Atomic Energy Research Establishment, Harwell, Berks, Eng.); Bredl. J. J. Phot. Sci., 12: 284-6(Sept.-Oct. 1964).

An Automatic Film Numbering and Coding Machine was developed along with an Automatic Recording Densitometer for reading photographic film detectors. The densitometer also performs an approximate conversion to equivalent gamma dose that is printed out for immediate reference if required. The automatic coding machine handles films at the rate of 60 per min. It provides the x-ray coding in addition to the conventional impressed/arabic number. (P.C.H.)

30549 LABORATORY CALIBRATION OF SEVERAL HIGH-SPEED FILMS WITH 2-14 Å X-RAYS. P. A. Atkinson and K. A. Pounds (Univ. of Leicester, Eng.). J. Phot. Sci., 12: 302-6(Nov.-Dec. 1964).

Four high-speed x-ray films were examined for absolute photon sensitivities (commercial Ilford Industrial x-ray film (type G), a single layer unsupercoated Ilford Industrial G, unsupercoated Kodirex, and Kodak-Pathe-SC5) over the wavelength range 2 to 14.5 Å. The precision and repeatability of calibration for a given batch of film are discussed. Measurements of the inherent grain photon equivalence for two emulsions are also given. Actual grain counts were taken after exposures of the special Ilford G and the Kodak SC5 emulsions at 2.1Å. The mean values of several counts on areas of density (D) = 0.1 gave the following equivalents: Ilford G, 1.8 photons absorbed per grain developed; Kodak SC5, 1.4 photons absorbed per grain developed. It appears that any uni-photon-grain plateau must lie to the short wavelength side of 2.1 Å. It was noted that the D-E (density-exposure) curve for the special Ilford G at 14.5 Å showed a sensitivity toe, such as would be expected when the number of photons per grain becomes appreciably greater than unity. The results also showed a less than 10% change over the temperature range 20 to 78°C. These results establish that precise quantitative x-ray measurements are feasible with a photographic emulsion, where lab calibration is made on the actual film batch being used. (TCO)

30550 LATENSIFICATION IN RADIOGRAPHIC EMULSIONS. William L. McLaughlin (National Bureau of Standards, Washington, D. C.). J. Phot. Sci., 13: 1-11(Jan.-Feb. 1965).

An investigation was made of the feasibility of applying several selected postexposures of visible light or near ir, by adjusting various factors to provide enhancement of the response of radiographic emulsions, thus permitting higher accuracy of lower exposure readings in photographic dosimetry. Three sensitive double-coated radiographic emulsions in dental-size packets were used. The 1.25-Mev γ radiation from a ^{60}Co source was used for most of the studies. For an energy dependence study, ^{137}Cs γ rays and heavily filtered x rays of different peak kilovoltages were also used. In some instances, a chemical additive was used to intensify development. The results showed that latensification by such postexposures provides as much as three-fold enhancement of response of x-ray emulsions to ionizing photons. The sensitivity could be similarly enhanced by the special development procedures. A combination of these techniques permitted five- or six-fold increase in sensitivity in the low-density region for some emulsions. Spectral sensitivity changes in the x- and γ-ray response were small; no rate dependence was observed. Variations in total density, however, were found with differences in delay period between exposure and postexposure and between postexposure and processing. The effects were explained by the change in the size and location of development centers resulting in an improvement of development activity, and therefore in a larger number of developed grains. In some instances, there was an increase in developed grain size. It is concluded that with films for which the lower limit of total exposure readings in conventional dosimetry is 20 mR, these described procedures should permit evaluations of about 3 or 4 mR with similar accuracy. (BBB)

30551 A PRACTICAL METHOD OF PERSONNEL MONITORING FOR BETA RADIATIONS USING PHOTOGRAPHIC EMULSIONS. Jones, B. E.; Marshall, T. O. J. Phot. Sci., 13: 12-19(Jan.-Feb. 1965).

A practical system for the personnel monitoring of β radiations was devised employing photographic emulsions together with a system of plastic filters. Beta dose rates were measured with an extrapolation chamber in Rads in soft tissue and the sources of β radiation were manufactured using pure β emitters with maximum energies ranging from 0.17 to 3.5 Mev. Measurements show the most suitable system to be one that divides the film into three areas, two of which are covered with plastic filters of thickness 50 mg/cm^2 and 300 mg/cm^2, respectively, while the other is unfiltered. The method of calibration of this filter system is described, together with a method of dose estimation for single doses of β radiation and the majority of β-γ mixtures. Certain problems regarding calibration and dose evaluation are discussed together with several miscellaneous problems pertinent to personnel dosimetry of β rays with films. (auth)

30552 PHOTOGRAPHIC RADIATION DOSIMETRY AND THE DEVELOPMENT OF THE A.E.R.E./R.P.S. FILM DOSIMETER. Heard, M. J. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Phot. Sci., 13: 32-7(Jan.-Feb. 1965). (AERE-M-1370)

The mechanism of photographic response to ionizing radiation is summarized and the requirements of a photographic film dosimeter are reviewed, along with the more important types of design that have been evolved. The design of the A.E.R.E./R.P.S. film holder is considered in more detail together with its basic response characteristics. (auth)

30553 EXPLANATION BY ADSORPTION, OF THE INFLUENCE OF TEMPERATURE ON SELF-QUENCHING GEIGER-MUELLER COUNTERS. A. Peeva (Faculte de Physique, Sofia). J. Phys., (Paris), 26: 126A-8A(Mar. 1965). (In French)

Using the method of delayed coincidences a study was made on the dependence of the existence of spurious counts in self-quenching Geiger-Müller counters on: different temperatures of the counters; electric current passing through the wire-anode; and fatigue of the counters. The study makes it possible to verify suppositions that the spurious counts, which deteriorate the counter characteristics, are due to variation of the adsorption of the polyatomic molecules around the wire-anode. (auth)

30554 DEAD TIME CORRECTION. PART I. E. G. Andresen (Staatliche Ingenieurschule Gauss, Berlin). Kerntechnik, 7: 79-81(Feb. 1965). (In German)

The mathematical formulation for the evaluation of the counting loss caused by the dead time is derived. The physical behavior with respect to the dead time is discussed. It is determined the dead time is not a constant and is not a property of the counting tube alone. (J.S.R.)

30555 INVESTIGATION OF SCATTERED ULTRAVIOLET RADIATION IN THE UPPER ATMOSPHERE OF THE EARTH. I. APPARATUS. S. I. Babinchenko, I. P. Karpinskii, S. A. Kaplan, V. V. Katyushina, L. N. Krylov, V. G. Kurt, R. M. Pustovait, and A. V. Shifrin. Kosmich. Issled., 3: 237-43(Mar.-Apr. 1965). (In Russian)

Photon counters used in investigations of scattered u-v radiation in the upper atmosphere are described. The two counters, of the SFM-1-type, are filled with NO and have LiF radiation windows for measurements within the region from 1050 to 1340 Å. The counters were selected for their narrow sensitivity band and comparatively high quantum yield (0.01 to 0.1). Pulses from a counter are recorded by a two-channel logarithmic rate meter within the interval from 2 to 2×10^3 pps. However, slot width and brightness were selected so that the counting rate does not exceed 1000 pps, which keeps it within the linear portion of the

counting characteristic. The operating voltage of the counters is 1000 v. The counter circuitry includes a preamplifier, trigger, pulse normalizer, storage circuit, transistorized d-c amplifier, supply-voltage regulator, and high-voltage converter for power supply. The modular design of the system provides a high degree of miniaturization and reliability. (ATD)

30556 ICE CALORIMETER FOR MEASURING THE ABSORBED DOSE OF GAMMA RADIATION. V. S. Grammatikati. Med. Radiol., 9: No. 9, 85-7(Sept. 1964). (In Russian)

The calorimetric method for determining the absolute value of the absorbed radiation dose yields accurate results but its low sensitivity and complicated nature prevented its widespread application. The method was found to be very suitable for measuring the absorbed dose from high-power γ sources in the dose rate range from 10^2 to 10^4 rad/min and total doses from 10^4 to 10^7 rad, since in these cases sensitivity is relatively unimportant. Ice was used as tissue-equivalent material in experiments aimed at the determination of the absolute dose of a ^{60}Co source by means of an isothermic ice calorimeter. At dose rates of 300 and 50,000 rad/min, an accuracy of 2 to 3% was obtained. Comparison tests with a ferrosulfate dosimeter agreed with the calorimetric data within ±5%. Tests were also carried out with an adiabatic calorimeter, the walls of which were held at the same temperature as that of the absorber. The sensitivity of the latter method was about 10,000 rad. It was found useful for the calibration of chemical dosimeters, ionization monitors, and thermoluminescent dosimeters used for measuring large doses. (TTT)

30557 NEW SCINTILLATION MATERIALS FOR DOSIMETRY OF ROENTGEN- AND GAMMA-RADIATION. S. P. Vershinina, G. P. Zaplesnichenko, L. N. Kolesnikov, Zh. V. Skuratovskaya, A. V. Chernobai, and Yu. A. Tsirlin (All-Union Scientific-Research Inst. of Monocrystals, Scintillation Materials, and Pure Chemicals, Kharkov). Med. Radiol., 10: No. 4, 73-4(Apr. 1965). (In Russian)

Dosimetric properties were studied in combined scintillation detectors consisting of: scintillating plastic with the addition of silver-activated zinc sulfide, thallium-activated potassium iodide, thallium-activated cesium iodide, potassium bromide, sodium chloride, potassium chloride, tetraphenyl lead and tetraphenyl tin. The detectors may be used for the dosimetry of gamma radiation. (auth)

30558 FIRST PERSONAL EXPERIMENTS IN THERMOLUMINESCENCE DOSIMETRY. R. Renzi (Universita, Florence). Minerva Nucl., 9: 36-40(Jan.-Feb. 1965). (In Italian)

The mechanisms of thermoluminescence and its use in dosimetry of ionizing radiations are discussed. The instruments used are described. Some experimental data obtained on calibration, estimates of sensitivity as a function of the energy, stability, and response as a function of the dose are presented. (auth)

30559 SCINTILLATION RESPONSE OF HORNYAK BUTTON-TYPE SCINTILLATOR FOR FAST NEUTRONS. Yong Tae Lee. New Phys. (Korea), 3: No. 1, 30-3(1963).

A Hornyak button-type scintillator for the detection of fast neutrons was prepared and its detection efficiencies for γ rays and fast neutrons were determined. The ratio of powdered ZnS(Ag) and paraffin was 2 : 3 by weight. ZnS(Ag) was used as scintillator and paraffin as recoil proton emitter. To increase the exposed area to the photomultiplier tube, the ZnS(Ag) + paraffin was poured into the space of the concentric cylinders of polyvinyl toluene. A polyvinyl toluene column was connected between the button and the photomultiplier to guide scintillations uniformly to the photomultiplier. The detection efficiencies of 4% and 1.85% were attained for Po–Be fast neutrons at the two discriminator bias settings when the counts of fast neutrons were ten times and one hundred times respectively as much as those of γ-rays. (auth)

30560 A THREE-QUADRANT DOUBLE-FOCUSING BETA-RAY SPECTROMETER AND THE MEASURED BETA-RAY ENERGY SPECTRUM OF ^{198}Au. Se Hee Ahn, Choong Hyun Chung, and Sung Ho Choh. New Phys. (Korea), 3: No. 2, 12-18(1963). (In Korean)

A three quadrant double focusing beta spectrometer is designed to focus the beta ray from the source outside the magnetic field, through any angle up to radian inside the magnetic field; or to focus the beta particle from the source inside the magnetic field, through any angle up to $\sqrt{2}\pi$ radian outside the magnetic field. It is possible to measure e-γ correlation when the source is set up outside the magnetic field, or to measure accurately the beta energy by using a pair of this type of spectrometer. Data were obtained on the magnetic field characteristics such as the magnetic properties of the magnetic core, the field drop at the magnetic shielding plate window. The beta energy spectrum of ^{198}Au was measured by the spectrometer. These results coincide with previous measurements. The comparison of the solid angles at various deflection angles shows expected results. (auth)

30561 PULSE HEIGHT DEFECT FOR Al^{27} AND Mg^{24} IONS IN SILICON SURFACE BARRIER DETECTORS. P. G. Bizzeti, A. M. Bizzeti Sona, G. Di Caporiacco, and M. Mando (Universita, Florence and INFN, Florence). Nucl. Instr. Methods, 34: 261-5(June 1965).

Silicon surface barrier detectors are shown to exhibit a pulse height defect for low energy ^{27}Al and ^{24}Mg ions. The ions were produced inside the detector as the recoils of the ^{28}Si (γ,p) and (γ,α) reactions by monochromatic γ rays of 17.6 Mev. The pulse height defect ranges from 70 to 152 kev for ^{27}Al ions of 91 and 225 kev respectively, while for ^{24}Mg ions it is 138 and 145 kev for energies of 910 kev and 1105 kev. It is temperature independent (from −70 to +20°C) and does not vary when the electric field is varied by a factor 2. The evidence suggests that the effect is due to a reduction of the efficiency in the electron-hole production when the ions are sufficiently slowed down. (auth)

30562 A SCINTILLATION TELESCOPE SPECTROMETER FOR DEUTERONS AND PROTONS WITH ENERGIES IN THE RANGE 50 TO 150 Mev. J. G. Asbury and F. J. Loeffler (Purdue Univ., Lafayette, Ind.). Nucl. Instr. Methods, 34: 284-8(June 1965).

A telescope consisting of scintillation counters and subtending a relatively large solid angle was devised which can distinguish deuterons in a sea of protons and pions. Pulse heights from the counters are used to determine the energy E and the specific energy loss dE/dX of the particles. Use was made of the fact that the product EdE/dX is a fairly sensitive function of the particle mass. The device described was used to detect deuterons with energies between 100 and 150 Mev and protons with energies between 50 and 100 Mev. These ranges can be extended subject to the usual limitations of counter telescopes. (auth)

30563 THE MEASUREMENT OF FISSION FRAGMENT TIMES OF FLIGHT. W. F. Mruk (Oak Ridge National Lab., Tenn.). Nucl. Instr. Methods, 34: 293-306(June 1965).

In the course of assembling and testing a fission fragment double time-of-flight apparatus at the Oak Ridge National Laboratory Research Reactor, a number of measurement problems of a fundamental nature appeared. It was found, for example, that an amplitude-rise-time (ART) effect exists and gives rise to timing errors, in some cases up to 20% in magnitude; that the apparatus is capable of measuring fission fragment velocities with a resolution of ~1%; and that the detectors provide the largest source of dispersion in timing measurement exclusive of prompt neutron emission from the fission fragments. Details are presented on the techniques involved in delay cable timing calibration, on the determination of source-backing thickness from timing spectra and on the experimental criteria which must be satisfied in order to measure fission fragment times of flight with high precision. (auth)

30564 A SELF TRIGGERING PROJECTION DISCHARGE CHAMBER. R. Giacomich and M. Lagonegro (Universita, Trieste). Nucl. Instr. Methods, 34: 347-8 (June 1965).

A spark chamber specifically designed for detecting fast

neutrons and analyzing their degree of polarization is described. This kind of measurement can be performed by using a chamber of projection discharge type provided it is filled with a gas whose polarizing properties are known well enough, as in the case of helium, for fast neutrons of energy ranging from 1 to 15 Mev. The chamber is filled with pure helium and is triggered when a recoil alpha particle, following an n-α elastic scattering, hits the bottom of the chamber. The bottom of the chamber is lined with a thin scintillation layer [ZnS(Ag)]. (C.E.S.)

30565 A WIDE-RANGE RADIATION MONITOR. E. Tagliaferri, D. Hansen, and C. York (Univ. of California, Los Angeles). Nucl. Instr. Methods, 34: 349-51(June 1965).

A radiation monitor for use with an accelerator is described. The monitor is a plastic scintillator-photomultiplier combination. The solid-state circuit used to integrate the current from the photomultiplier and to produce a pulse suitable for driving a scaling circuit is described in detail. (C.E.S.)

30566 AN ACCURATE METHOD FOR MEASURING ENERGIES AND FLIGHT DIRECTIONS OF NEUTRAL PIONS. L. Tau (Universita, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nucl. Instr. Methods, 34: 352 (June 1965).

The usual method of detecting a π^0 is through its decay photons using two lead-glass Cherenkov counters and two anticoincidence plastic scintillators to avoid counts from charged particles. A means for improving this method is proposed. A lead converter (~1 cm in thickness) followed by a thin spark chamber, which localizes the electron shower produced by the photon in the lead, is placed between the anticoincidence scintillator and the lead glass of each counter. (C.E.S.)

30567 LOSS OF PROTONS BY NUCLEAR INTERACTIONS IN SODIUM IODIDE CRYSTALS. D. F. Measday (Harvard Univ., Cambridge, Mass.). Nucl. Instr. Methods, 34: 353-5(June 1965).

In many experiments sodium iodide crystals are used to detect protons. For protons of 100 Mev about 10% of these undergo a nuclear reaction. If particles such as tritons are produced the crystal response is nonlinear because they have a high rate of energy loss. If neutrons or gamma rays are formed these can be lost from the crystal. Energy is also lost because most proton reactions have a negative Q value. For several reasons therefore the pulse height will be smaller for a proton that has undergone a nuclear reaction. An experiment to determine the proton inelastic cross section for sodium and iodine and to determine the loss corrections for a sodium iodide crystal is described. The loss correction is also determined for a plastic scintillator. (C.E.S.)

30568 dE/dx SURFACE-BARRIER SILICON DETECTORS. T. Krogulski, J. Chwaszczewska, and M. Jaskola (Inst. of Nuclear Research, Warsaw). Nukleonika, 10: 69-75(1965). (In Russian)

A new technology of type dE/dx surface-barrier detectors was developed. The detectors obtained had thickness 70, 50, 40, 30, and 25 μ, active area 1–1.5 cm^2 while their barrier could be broadened over the whole geometrical detector thickness. The detectors were studied by means of natural polonium and thorium α sources and 24-Mev α-particles and 127-Mev deuterons from the cyclotron. (P.C.H.)

30569 CALCULATION OF A GRAPHITE IONIZATION CHAMBER FOR MEASURING BREMSSTRAHLUNG-INTENSITY IN THE 1 TO 100 Mev ENERGY RANGE. G. A. Cherevatenko and V. V. Frolov. Pribory i Metody Analiza Izluchenii, Mosk. Inzh. Fiz. Inst., No. 3, 79-88(1962). (In Russian)

If the sensitivity of an ionization chamber to a given gamma radiation and the ionization of the chamber gas caused by this radiation are known, the intensity of the incident quanta can be calculated. The sensitivity to gammas of known energy in the range 1 to 100 Mev was calculated for a graphite chamber (density 1.8 g/cm^3) for wall thicknesses of 4.5 to 22.5 cm. The equations are developed mathematically, and the data are plotted and tabulated. The optimum sensitivity of a chamber for an unknown radiation spectrum is at an energy equal to half the upper limit of the spectrum of the bremsstrahlung radiation. The calculations presented make possible the construction of a thick-walled ionization chamber which can be used to measure the intensity of gamma quanta of unknown spectral composition in the energy range 3 to 100 Mev with a precision of ±10%. Experiments with different back wall thicknesses showed a negligible effect of back dispersion on ionization measurements. The correction on the shower process in the energy range up to 100 Mev for graphite was no more than 5%. (TTT)

30570 NOTE ON THE THEORY OF CAVITY IONIZATION CHAMBERS. L. V. Spencer (National Bureau of Standards, Washington, D. C.). Radiation Res., 25: 352-8 (June 1965).

A simple formula for the cavity ionization function $f_2(T_0, \Delta)$, has been used for several years, but a complete derivation has never been given. The integral defining this function is evaluated in such a way as to obtain the formula and indicate the size of some small correction terms. (auth)

30571 DETECTOR FOR GAMMA-ASTRONOMY IN THE 20-200 kev ENERGY RANGE. Domenico Brini, Umberto Ciriegi, and Franco Fuligni (CNR, Bologna and Universita, Bologna). Ric. Sci. Rend., Sez. A(2), 6: 565-610(Dec. 1964).

A scintillation detector for photons in the energy range from 20 to 200 kev is described in which an NaI(Tl) scintillator set in a box of lead and lead-glass is surrounded by a plastic scintillator. A theoretical evaluation of its characteristics is outlined, and experimental results are cited which support the evaluation. (D.C W.)

30572 GAS RADIOMETRY USING CYLINDRICAL COUNTERS WITHIN FIXED VOLUMES. V. M. Kolovashkin, M. V. Shulenko, and V. P. Zharkov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 5-9(1964). (In Russian)

The theory underlying determination of the concentration of β-radioactive gases using cylindrical counters within a fixed gas-filled volume showed that there is an optimum counter radius resulting in an optimum counter sensitivity. However, in most practical cases, this optimum cannot be achieved due to the finite radii of available counters. To circumvent this difficulty, it is proposed that the optimum counter volume be covered by a symmetrically distributed battery of 7 counters. Pertinent theoretical equations were derived, among other things, permit the relative change in counting rate when going over from a single counter to the combination of seven to be estimated within ±10%. Tests showed that the background of seven AS-1 counters in coincidence was extremely constant and equal to 26.3 ± 0.2 c/min, while each of the separate counters registered a background of 17 to 24 c/min. (CFSTI)

30573 INFLUENCE OF GAS MIXTURE COMPOSITION ON THE MAGNITUDE OF END EFFECTS IN INTERNALLY FILLED COUNTERS. V. I. Ivanov, V. M. Kolobashkin, O. V. Zakharov, and A. A. Greshilov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 10-11(1964). (In Russian)

The equation $\eta = (k/L/D - k)$, where η is count losses and L is the working length of the counter contains the experimental parameter k. Experimental verification of the values of k is reported. Tests showed that these k-values can be used whenever the amount of gas admixture is held below 15% and no more than 1% N_2 is present in the counter. (CFSTI)

30574 FAST NEUTRON SPECTROMETER. G. G. Doroshenko, I. V. Filyushkin, and V. A. Fedorov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 32-44(1964). (In Russian)

A fast neutron spectrometer was developed whose good linearity allows the attainment of an extremely low spectrometric resolution threshold (~80 kev on the emitted electron scale) at relatively high permissible loads (~5.10^3

c/sec). The 30 × 30 mm cylindrical stilbene crystal is connected to a photomultiplier. The electronic circuitry is described, and diagrams of the temporal separation of pulses, determination of the energy threshold, the shape of the Compton distribution, the ratio of the half-height energy to the maximum Compton electron energy as a function of the energy resolution (^{137}Cs γ quanta), the stilbene light yield as a function of emitted protons, and the inverse transposed stilbene crystal matrix are given. Test measurements of fast neutrons from Po-Be sources were in excellent agreement with the results of photoplage measurements and resonant cross section structure (neutron-oxygen interaction) data. (CFSTI)

30575 MEASURING DEVICE AT THE INPUT OF A NONLINEAR AMPLITUDE ANALYZER. V. A. Fedorov and G. G. Doroshenko. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 72-6(1964). (In Russian)

During amplitude analysis, it is necessary to separate the boundaries of the analyzer channels according to some given law. Such is the case in fast neutron spectroscopy, where the boundaries are separated according to the nonlinear law of scintillator light signals. The circuitry and operation of an input device, which differs from other known setups by the use of a threshold element whose triggering instant determines the address of the respective channel, are described. This is achieved by an appropriate change in the discriminator threshold time (from longer to shorter) through a distributed delay line. The channel number is determined by the number of pulses from the generator. (CFSTI)

30576 SENSITIVE STABLE AMPLITUDE DISCRIMINATOR. V. A. Fedorov and G. G. Doroshenko. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 77-81(1964). (In Russian)

The amplitude discriminator, one of the most important elements of a spectrometric device, is actually a nonlinear element generating a signal whenever the amplitude of the input signal exceeds the given discrimination threshold. An amplitude discriminator was designed around a highly sensitive monovibrator, which has a minimum clear operating threshold on the order of 1 to 2 mv. The discrimination threshold is controlled by the most stable discriminating element, the diode (provided it is thermally stabilized), while the tube circuitry of the monovibrator represents a special kind of zero element whose possible drift does not affect the operation of the entire device. The high sensitivity of the monovibrator circuit is achieved by a particular choice of tube operating points and by the use of the positive feed-back of the nonlinear diode quadrupole whose transfer coefficient is determined by the magnitude of the input signal. (CFSTI)

30577 PORTABLE DOSIMETER FOR INTERMEDIATE NEUTRONS. E. A. Kramer-Ageev and G. Z. Sedin. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 106-9(1964). (In Russian)

An instrument similar to Baggon's dosimeter was constructed using a thin (r = 6.3 cm) paraffin-filled Co sphere. At the center, a thermal neutron detector T-1, 3 mm thick and 26 mm in diameter, was placed. Distortions were reduced by means of a plexiglass light-guide between the scintillator and the cathode. The circuit diagram of the electronic part of the self-contained device is given. It is pointed out that the knowledge of the shielding material and the source type are necessary for a correct estimate of the intermediate neutron dosage. (CFSTI)

30578 ANALYSIS OF A PHOTOMULTIPLIER OPERATING IN THE NONLINEAR REGION. G. G. Doroshenko, V. A. Fedorov, I. R. Barabanov, and Yu. L. Grishin. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 110-24(1964). (In Russian)

Photomultipliers operating in the nonlinear region may exhibit valuable properties. An analysis was made of photomultipliers working under high saturation conditions. The analysis was based on experimental data concerning the dependence of the output pulses from various electrodes of the system on the energy of secondary particles (for NaI(Tl), anthrancene, stilbene, tolan, and naphthalene crystals), on the scintillation time of scintillators, and on the time constant of the RC load. The analysis utilized simple physical models of the observed events. Diagrams of the pulsed photomultipler current for various scintillators at E = 4.43 Mev, of the amplitude of the pulse voltage as a function of the saturation current for various scintillation times, of the current pulses for a scintillation time of 5 nsec and various degrees of uncertainty in the time of flight (describable by a constant T), of the dependence of the current and voltage pulse amplitudes on T, of the saturation amplitude versus the scintillation constant, and of the current and voltage pulses across the loads as a function of time are presented. The results of theoretical calculations were in good agreement with experimental data. (CFSTI)

30579 α-PARTICLE SPECTROMETER WITH SPHERIC SCINTILLATION CHAMBER. S. S. Lenin. Vopr. Rudn. Geofiz., Min. Geol. i Okhrany Nedr. SSSR, 4: 106-8(1964). (In Russian)

The coating of walls of the ionization chamber with a layer of the luminescent ZnS(Ag) permits (with the use of a photomultiplier) the counting of the scintillations generated in the internal surface during bombardment by α particles from a source situated in the center of the chamber. The energy of particles can be calculated from the known path length of α particles in air from the change in pressure. The apparatus has a resolving power of 6.2% and is highly sensitive. The pressure of air in the chamber is measured with an accuracy of ≤0.1 mm Hg. (auth)

30580 A TWO-CRYSTAL SCANNING-BED COUNTER FOR ACCURATE DETERMINATION OF WHOLE-BODY ACTIVITY. Y. Naversten (Univ. of Lund, Sweden). p.55-66 of STI/PUB/84(Vol. I).

Whole-body counters often utilize a detector in a chair arrangement. Such a geometry was used for potassium and ^{137}Cs measurements. However, for several elements or compounds redistributions within the body make this geometry not very well suited for whole-body activity determinations. A geometry with two scanning detectors, one above and one below a stretcher, was developed for the whole-body counters at Lund. The efficiency of this geometry with 5 × 4 in. NaI(Tl) crystals proved to be very insensitive to the distribution pattern of the activity within the body. Isoresponse curves for point sources in the 144/45-cm two-crystal scanning bed geometry are given, when no absorption losses are considered. The effect of redistributions of ^{131}I, ^{132}Cs and ^{47}Ca was studied by means of an Alderson phantom counted in both the 42-cm chair geometry and the 144/45-cm scanning bed geometry. An example from the clinical work with ^{85}Sr on patients is also given. Experience of the scanning-bed geometry shows that the whole-body activity may be assessed to within 15% accuracy, regardless of the distribution in the body. Improved scanning geometries with the patient lying on an arc, or geometries with two crystals moving in arc orbits are suggested. (auth)

30581 SHAPES OF SCINTILLATION SPECTRA. K. G. McNeill and V. K. Mohindra (Univ. of Toronto). p.79-86 of STI/PUB/84(Vol.I).

A series of experiments have been carried out to find the effect on the shape of scintillation spectra of self-scattering in the source material. This has application to the analysis of spectra obtained from persons internally contaminated with a mixture of unknown isotopes. Results with a uniform distribution of radioactivity in phantoms were previously published. The present paper describes experiments with point sources of gamma rays. As criteria of spectral shape, the effective resolution of the photopeak and the valley-to-peak ratio of the photopeak are taken. As variables, we have considered the detector-to-source distance, the scatterer thickness, the depth of the source in the scatterer and the gamma energy. As examples of the results obtained, the valley-to-peak ratio for a 5-in. NaI crystal varies by a factor of six as the depth of a source

of 0.28 Mev gammas alters from 0 to 22 cm in a scatterer of fixed geometry, while for 1.1 Mev gammas the corresponding factor is two. There are related changes in effective resolution, though the factors are not so large. Graphs are presented showing these changes and comparing them with the corresponding situations with uniformly distributed sources. (auth)

30582 HUMAN BETA BREMSSTRAHLUNG DETECTION BY MEANS OF THIN AND THICK SODIUM IODIDE CRYSTALS. L. G. Bengtsson (Univ. of Lund, Sweden). p.91-114 of STI/PUB/84(Vol.I).

Thin NaI(Tl) crystals have been used earlier in attempts to assess the body burden of beta-emitting nuclides in the human body by means of the bremsstrahlung produced in the body. In many respects large NaI(Tl) crystals are more advantageous. The two detector types are compared regarding their statistical properties and their performance when large amounts of interfering gamma emitters are present in the body of the measured subject. The use of 42-cm chair geometry versus 35- and 45-cm scanning bed geometry is discussed. An account is given of the influence of body weight and shape on the background spectrum and on the spectra of ^{137}Cs and ^{40}K. Possible errors in the assay are discussed. Results obtained from measurements of several subjects with an 8 × 4 in. crystal in the scanning bed geometry are reported. The excess count in the energy interval used for bremsstrahlung assay was in all cases, if no unknown contamination was present, less than the count corresponding to 3 SD (theoretically obtained standard deviation). The minimum detectable amount of any beta emitter, using the reported method, is thus expected to be that which corresponds to 3 SD. A 2-hr measurement shared on subject and background would then reveal a contamination of about 40 nC ^{90}Sr + ^{90}Y in a subject containing 50 nC ^{137}Cs. (auth)

30583 NEW PROPORTIONAL COUNTER SUITED TO THE IN VIVO DETECTION OF PLUTONIUM TRACES IN THE LUNGS. A. Lansiart and J.-P. Morucci (Commissariat a l'Energie Atomique, Saclay, France). p.131-40 of STI/PUB/84(Vol.I). (In French)

The construction of a gas proportional counter with an effective detecting surface of 250 cm^2 and a sensitivity approximately equal to that obtainable with a scintillating crystal is described. In simplified terms, it consists of two superposed multi-wire counters within the same chamber, one serving as detector and the other to reduce background by anti-coincidence. The window is of beryllium 1 mm thick and the instrument is filled with xenon at a pressure of 2 atm. An important feature of this counter is the excellent uniformity of detection over the entire window surface. This uniformity is obtained by means of corrections for the edge effects, these corrections being very easy to apply. The wires are 25 μm diam. and 3 cm apart, so that it is possible to use much lower voltages than are customary in this type of detector and to suppress parasitic pulses due to spurious emissions. Data obtained from a contaminated animal are presented. (auth)

30584 PERFORMANCE OF AN ARRANGEMENT OF SEVERAL LARGE-AREA PROPORTIONAL COUNTERS FOR THE ASSESSMENT OF Pu^{239} LUNG BURDENS. R. Ehret, H. Kiefer, R. Maushart, and G. Moehrle (Kernforschungszentrum, Karlsruhe, Ger.). p.141-49 of STI/PUB/84(Vol.I).

If plutonium-239 is deposited in the human lung, some of the emitted soft x-rays can be measured from the outside by proportional counters. Efficiency of such measurements depends on sensitive area and geometrical arrangement of the counters in regard to the body, on absorption of the x rays inside the counter, on reduction of the radiation in the wall or window of the counter, on the background of the counter, and on stability of this background in spite of β and γ radiations coming from other nuclides than plutonium-239 in the body. Most of these parameters are optimized by using three large-area, thin-window, argon-filled proportional counters mounted inside a large steel-room opposite the chest and both lung lobes of a sitting patient. These counters are anti-coincidence shielded in such a way that only soft x rays causing the origination of photoelectrons inside the measuring counter proper are detected. The effect is enforced by passing the electrical pulses through a one-channel pulse height analyzer. Construction and performance of such an arrangement are described in the paper. (auth)

30585 HIGH PRESSURE GAMMA CHAMBER (Engineering Materials). (Oak Ridge National Lab., Tenn.). 6 drawings. (CAPE-1238)

Drawings (6) are presented for an ionization chamber that is used to detect weak gamma activity from ^{235}U in uranium compounds. The chamber, which is placed in the compound, consists of a lucite can 2¾ in. ID, 3 in. OD, and ¼ in. high. It is mounted in a lucite vessel 10½ in. in dia., 11⅞ in. high, and is housed in a wrought steel seamless pipe 12 in. in dia., and 16 in. long. The galvanized steel grid is located between the lucite vessels. The chamber's maximum working pressure is 1500 psig, however, it is hydrostatically tested to 2250 psig. (P.C.H.)

30586 FIVE-DECADE LOG COUNT RATE METER (Engineering Materials). (Oak Ridge National Lab., Tenn.). 5 drawings. (CAPE-991)

The log count rate meter is used to count pulses. It has a range from 1 to 10^5 counts/sec, employs a logarithmic diode, and is tailored to receive input from an A-1 amplifier. (P.C.H.)

30587 SOURCES OF ERROR IN PHOSPHATE GLASS DOSIMETRY: RADIOPHOTOLUMINESCENCE AND ABSORPTION ALTERATIONS AFTER EXPOSURE. K. Becker (Kernforschungsanlage, Julich, Ger.). Vienna, International Atomic Energy Agency, World Health Organization, 1965, Preprint No. SM-56/21, 27p. (CONF-650302-14).

From IAEA Symposium on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation, Vienna.

Recently developed silver-activated glass dosimeters are superior to photographic film and thermoluminescent dosimeters for many reasons that are described briefly. A main disadvantage of glass dosimeters is possible changes in the fluorimetric or in the photometric dose reading between exposure and evaluation. Ultraviolet irradiation can induce or destroy radioinduced fluorescence and color centers in the glass, depending on the quantum energy of the uv light. More important in practice, is the increase of the measured RPL immediately after exposure, superimposed later by the fading process. Increase and decrease rates depend strongly on the storage temperature and the composition of the glass. For instance, the increase after exposure decreases with increasing silver concentration in a glass with constant basic composition, and the fading occurs earlier. At constant silver concentration there is also an effect of different glass base compositions. There are no observable differences in the kinetics of x-ray, γ-ray and thermal neutron effects in the glass. In the 10^{-2} to 10^3 Ry dose range (fluorimetric dose reading) the kinetic behavior of the RPL centers determines this effect, while in the 10^3 to 10^7 R dose range the somewhat different stability of the absorption centers is important if absorption measurements are taken (the fading depends on the wavelength of the photometric measurement and is lowest at the 320 mμ absorption band). If fluorimetric measurements are also taken, the superimposing effects determine the dose reading because of the uv absorption in the glass at the fluorimetric reading. A brief theoretical interpretation of the kinetics in irradiated glass is given by using a simplified band model of the physical processes involved. A general expression for the possible radiation effect alterations is given. After a high dose exposure the glass can be regenerated by a special heat treatment. Too-extended heating or too-high temperatures may increase the predose. Possible inaccuracies in the dose measurement can be overcome practically by a short heat treatment of the glass (stabilization or development of the radiation effect) or the use of the correction curves given in the paper. The uv-induced RPL behaves somewhat differently. (auth)

30588 THE MEASUREMENT OF INTEGRATED GAMMA-RAY DOSES IN THE RANGE 50 mr–5 Mr USING PHOSPHATE GLASS AND LITHIUM FLUORIDE. G. A. M. Webb (Central Electricity Generating Board, Gloucestershire, Eng.). Vienna, International Atomic Energy Agency, World Health Organization, 1965, Preprint No. SM-56/45, 26p. (CONF-650302-18).

From IAEA Symposium on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation, Vienna.

The radiophotoluminescence and color-change of phosphate glass and the thermoluminescence of lithium fluoride were compared as the basis of dosimetry systems over the range of γ-ray doses from 50 millirads to 5 megarads. The stimulated luminescence of low-Z silver-activated phosphate glass was measured on a commercial fluorimeter (Toshiba fluoroglass dosimeter) supplemented by a spectrophotometer to measure the change of optical density for the high-dose region. The effects of various cleaning procedures for the glass were studied. The thermoluminescence of lithium fluoride was measured using a laboratory reader to produce glow curves and then integrating the area under the required peak. The emission spectrum of the thermoluminescence was measured using optical filters, which were also used to minimize the effects due to infrared radiation from the heating tray. The effects on the tribothermoluminescent peak of optical filters and readout under nitrogen were investigated. A number of performance criteria of the two systems were investigated and compared critically. The range of the glass is very large, from 5×10^{-2}–5×10^{6} rads, i.e. a dynamic range of 10^{8}, whereas LiF, although it may be used for slightly lower doses, saturates above 10^{5} rads. The LiF is almost energy-dependent, but glass shows a maximum departure of seven times the response to ^{60}Co at 60 kev; this may be corrected by shielding at the expense of raising the lower energy limit. The fading of the glass was thoroughly investigated; that of LiF, which is not so marked, was studied to a lesser extent. Annealing and re-use of both glass and LiF is possible and various annealing cycles were tried for each; the sensitivity for re-use also was measured. The effects of temperature of irradiation and storage in the range 20-100°C were studied for each system, as has the evaluation of doses in mixed neutron and γ-ray fluxes. A comparison is made of the two systems for general convenience and also for use in particular situations. (auth)

30589 IMPROVEMENTS IN MEANS FOR AUTOMATICALLY DETERMINING THE INDIVIDUAL DEGREE OF RADIOACTIVITY OF A PLURALITY OF BODIES. Willie Ellis Thompson and Walter Henry Legon (to E. K. Cole Ltd.). British Patent 983,927. Feb. 24, 1965. Filed Apr. 19, 1962.

An apparatus for detecting and measuring the radioactivity of samples in containers of a wide variety of shapes and sizes and in relatively large numbers includes a chamber and a conveyor chain for moving the containers step by step towards the chamber. The conveyor chain is provided with evenly spaced supports, each adapted to carry a container of a sample under test, and the conveyor is guided by sprocket wheels or the like. The chamber houses a detector and includes a door that is automatically closed after the introduction of each container to prevent interfering radiation from entering the chamber. After the sample has been tested, the chamber is automatically re-opened, and a transverse arm extends into the chamber and removes the sample. The transverse arm removes the container by lowering a grab to engage the container and raising it before any transverse motion is actuated. The transverse arm is driven from a chain and sprocket mechanism synchronized with the conveyor chain drive. The detector is set to record or indicate above a predetermined level of radioactivity. (B.L.M.)

30590 POCKET DOSIMETER WITH RADIATION CELL. Bernhard Hess, Rolf Hosemann, and Harald Warrikhoff (to Licentia Patent-Verwaltungs-GmbH). Canadian Patent 679,232. Feb. 4, 1964. Priority date May 24, 1957, Germany.

A pocket dosimeter for measuring the dose or dose output of x rays, gamma rays, and neutrons is characterized in that a Hess radiation cell is used in conjunction with an electrometer. The radiation cell and electrometer are enclosed in a vacuum container, eliminating the need for electrical contacts leading outside the cell. The radiation cell consists of two or more suitably shaped electrodes that are enclosed one inside the other in such a way that the dosimeter will have the same sensitivity over a very wide solid angle to the primary radiation. The electrodes may take the shape of concentric spherical shells, concentric prisms, or concentric cylinders closed at one or both ends with covers. (B.L.M.)

30591 GEIGER-MÜLLER COUNTER TUBE. Kornelis Nienhuis and Kars van Duuren (to N. V. Philips' Gloeilampenfabrieken). Canadian Patent 684,426. Apr. 14, 1964. Priority date Oct. 14 1960, Netherlands.

In the Geiger-Mueller tube the discharge space is filled with an ionizable gas containing at least 0.005% and at most 25% by volume of a halogen and the remainder with a rare gas. The cathode surrounds the discharge space, and the anode is arranged inside the cathode and is characterized in that the distance between it and the cathode is smaller at a restricted number of places than one-quarter of the mean distance between the anode and cathode. During the operation of the tube, a field intensity of a considerably higher value than the mean field intensity is produced at the cathode at the places where the distance between the cathode and anode is smaller. The tube has a considerably shorter dead time, the starting voltage is lower, and a longer and flatter plateau is obtained than with tubes of similar structure that lack the places where the distance between the cathode and anode is smaller than one-quarter of the mean distance between the two. (B.L.M.)

30592 SOLID STATE POWER MAPPING INSTRUMENT. Robert Steinberg and William B. Schwab (to U. S. Atomic Energy Commission). U. S. Patent 3,160,567. Dec. 8, 1964.

A radiation detector was designed for mapping reactor neutron flux. It consists of a plurality of probes, each probe having a plurality of ^{235}U-coated p-n junction diodes connected in series, means to guide the probes along a fuel element, a motor drive, and means for determining the position of the probes along the fuel element. (AEC)

Radiation Effects

Refer also to abstract 31601.

30593 (AD-608959) EXPLORATORY DEVELOPMENT OF THE Q-FACTOR TECHNIQUE. Report No. 2645. First Quarterly Progress Letter for the Period Ended, June 30, 1964. Max Frank (Bendix Corp., Southfield, Mich. Research Labs. Div.). July 10, 1964. Contract AF29(601)-6316. $3.00(CFSTI).

Results are presented of two gamma radiation tests performed to study gain degradation of the 2N1613 and 2N2378 silicon transistors under various operating and measurement conditions. The damage is analyzed using the Q-factor technique of series testing and linear damage variations with flux. Base transit time measurements are used to correlate differences in gain damage rates with differences in base geometry and doping between transistors of the same type. The damage constants derived from the radiation tests were found to be dependent upon the particular set of irradiation and measurement conditions employed. (auth)

30594 (AD-608961) EXPLORATORY DEVELOPMENT OF THE Q-FACTOR TECHNIQUE. Second Quarterly Progress Letter for the Period Ended, September 30, 1964. Max Frank (Bendix Corp., Southfield, Mich. Research Labs. Div.). Oct. 10, 1964. Contract AF29(601)-6316. 47p. $2.00(CFSTI).

Gamma radiation tests were performed on 2N1613 transistors to study differences in gain degradation between passive and various transistor operating conditions during irradiation. The influence of emitter current alone and

collector voltage alone were investigated to determine how each of these parameters behave and to explain the combined effect observed. The effects on gain degradation of different temperatures and measurement at different current levels were also studied in the gamma tests. The results of several active-to-passive gain degradation comparisons for a neutron exposure are included. (auth)

30595 (GA-6008) TRANSIENT AND DISPLACEMENT EFFECTS TESTS WITH AN ACCELERATOR PULSED FAST ASSEMBLY. V. A. J. van Lint and J. W. Harrity (General Atomic, San Diego, Calif.). Mar. 1965. Contract AF29(601)-6662. 62p. (AFWL-TR-65-2)

Displacement and ionization radiation effects tests were performed with an Accelerator Pulsed Fast Assembly and compared with linear accelerator and TRIGA pulsed reactor tests. Specific measurements were made on the annealing of beta degradation in npn and pnp silicon transistors and on the conductivity induced by a short neutron-gamma pulse in a 0.5 μF Mylar capacitor. The results indicate no measurable annealing of the damage in npn transistors, but a significant (factor of ~2) annealing with a decay time ~100 μsec in pnp transistors. The conductivity induced in the Mylar capacitor could be attributed predominantly to the gamma component and exhibited no unusual behavior due to the short neutron pulse. (auth)

ISOTOPE TECHNOLOGY

General

30596 (BNL-8909) FOUR LECTURES ON ISOTOPE PRODUCTION AND UTILIZATION. I. PRACTICAL CONSIDERATIONS IN APPLYING RADIOCHEMISTRY AND NUCLEAR CHEMISTRY. II. PRODUCTION OF SPECIAL RADIOISOTOPES. GENERAL. III. PRODUCTION OF SPECIAL RADIOISOTOPES. DETAILS. IV. THE PEACEFUL (NON-POWER) APPLICATIONS OF ATOMIC ENERGY. Louis G. Stang, Jr. (Brookhaven National Lab., Upton, N. Y.). 1964. Contract AT(30-2)-Gen-16. 82p. Dep. (mn); $3.00(cy), 2(mn) CFSTI.

The first lecture treats these practical considerations which should be taken into account in producing radioisotopes and utilizing them as tracers. Equations are given for mathematical relations of importance in the production and utilization. The next two lectures discuss various aspects of the production of short-lived isotopes at Brookhaven. In the last lecture, applications of radiation and radioisotopes are discussed. (D.L.C.)

Industrial Applications

Refer also to abstracts 30234 and 30499.

30597 (TID-21404) APPLICATION OF RADIATION-PASTEURIZATION PROCESSES TO PACIFIC CRAB AND FLOUNDER. Final Summary, November 1963–October 1964. (Bureau of Commercial Fisheries, Seattle, Wash. Technological Lab.). Nov. 1964. Contract AT(49-11)-2058. 124p. Dep.; $4.00(cy), 3(mn) CFSTI.

Progress is reported in studies on the effects of radiation processing on the extension of refrigerated storage life and wholesomeness of Pacific crab meat and flounder fillets. Irradiation at 0.2 megarad resulted in a storage life of about 4 weeks at 33°F, but the product gradually deteriorated in quality the longer it was kept in refrigerated storage. Evidence of these changes was reflected in decreases in sensory scores with increasing refrigerated-storage time. Procedures and results are presented for chemical, physical, and microbiological tests of radioinduced changes in quality of crab meat and flounder fillets. (C.H.)

30598 (TID-21431) CURRENT STATUS AND COMMERCIAL PROSPECTS FOR RADIATION PRESERVATION OF FOOD. (Business and Defense Services Administration, Washington, D. C.). Jan. 1965. Contract AT(49-11)-2524. 184p. Dep.; $0.55(cy), 3(mn) GPO.

The status of radiation preservation of food in 1965 is reviewed. Processes and equipment used in food irradiation are described and the present state of food technology is discussed for selected products. Emphasis is placed on the radiation processing of fresh and cured pork, beef, poultry, and sea foods; the radiation pasteurization of fruits; the radiation disinfestation of wheat and other grain products, pork, certain tropical fruits, and dried or frozen eggs; and the radiation processing of potatoes for sprout inhibition. Government regulations affecting food irradiation are summarized and the potential economic impact of food irradiation is discussed. The status of foreign research programs is reviewed. (185 references.) (C.H.)

30599 (TID-21710) STUDY OF APPLICABILITY OF RADIATION PASTEURIZATION OF FRUITS IN THE SOUTH. (Southern Interstate Nuclear Board, Atlanta, Ga.). Sept. 15, 1964. Contract AT(38-1)-368. 118p. Dep.; $4.00(cy), 3(mn) CFSTI.

The effects of radiation pasteurization on spoilage incurred in the marketing systems for grapefruit, oranges, peaches, strawberries, and tomatoes grown in the Southern U. S. were investigated. The results show that the value of grapefruit, oranges, and peaches saved was not sufficient to cover the cost of irradiation. The value of strawberries and tomatoes saved was more than the cost of irradiation. It is pointed out that the study was restricted to the domestic market and irradiation may be feasible for fruits for foreign shipment. (C.H.)

30600 (JPRS-29912(p.6-14)) EFFECT UPON THE ORGANISM OF DOGS OF MEAT PRODUCTS IRRADIATED WITH PASTEURIZING DOSES OF GAMMA-RADIATION. Yu. I. Shillinger, B. G. Kachkova, and N. B. Maganova. Translated from Vopr. Pitaniya, 24: No. 1, 19-24(Jan.-Feb. 1965).

Dogs were fed a diet containing from 160 to 250 g irradiated beef or from 172 to 269 g irradiated pork for a period of 18 mo. Tests of certain aspects of protein, lipid, and carbohydrate metabolism were conducted periodically. The irradiated meat had no toxic effects on the dogs or on metabolic indices or results of clinical tests conducted on the dogs. (C.H.)

30601 FACTORS CAPABLE OF CAUSING ORGANOLEPTIC MODIFICATIONS IN IRRADIATED FOODS. P.-L. Sarrazin and P. Vidal (S. A. Conservatome, Lyon). Ann. Nutr. Aliment., 17: 463-74(1963). (In French)

Doses of ^{60}Co irradiation below 50 krad did not provoke organoleptic modification in the treated products. Ten to 15 Krad degerminated food tubers and bulbs. Fifteen to 20 Krad destroyed insects in cereals, fruits, and spices. Thirty to 45 Krad destroyed meat and seafood parasites. Doses above 250 or 300 Krad modified the texture of raw fruit because of lysis of the cells. It was not possible to radiosterilize green vegetables without modifying their texture. For nonshelled frozen eggs, the organoleptic modifications were a function of the irradiation dosage. There was a slight attenuation of color at 250 or 300 Krad, but a decrease in viscosity appeared only after a dose of one Mrad. Doses necessary to radiosterilize fish produced changes in odor and flavor, while those for pasteurization did not. Irradiation with 250 to 500 Krad provoked an accentuation in color of raw pork and mutton and caused darkening of beef. No unpleasant odor was caused in raw meat by a dose less than one Mrad. The color and odor of cooked meat were not affected by doses less than 2.5 Mrad. Color modifications of the foods seemed due to oxidation of the myoglobin or radiochemical action on the carotenoids. The oxidation of fish fats exposed to doses greater than one Mrad provoked an odor resembling cod liver oil. Organoleptic modifications were due to: direct or indirect oxidation phenomena, radiodecomposition, or radiolysis of the cells. The environment of the food product can be modified to minimize these causes. No packaging material was found which would properly maintain the products. (BBB)

30602 THE PROTECTION OF FOODSTUFF AGAINST RAVAGING INSECTS BY THE USE OF IONIZING RADIATIONS IN ORDER TO OBTAIN THE STERILITY OF ADULT INSECTS. SPECIAL STUDY OF THE GONAD REACTION OF SITOPHILUS GRANARIUS. P. Pesson and J.-M. Vernier (Institut National Agronomique, Paris). Ann. Nutr. Aliment., 17: B487-97(1963). (In French)

The histological modifications produced in the gonads of Sitophilus granarius by irradiation made in the larva and nymph stages were studied. The testicle and ovary react differently in the larva and in the adult. In the male spermiogenesis is not definitely inhibited for the very advanced stages and the younger stages can regain later their multiplying capacity and undergo maturation divisions. However the spermatozoids resulting from this resumption of the spermiogenesis can carry lethal factors resulting from genic or chromosonic modifications. In the females the irradiation of the larva or the nymph caused sterilization. (J.S.R.)

30603 THERMO- AND RADIOSUSCEPTIBILITY OF THE VITAMINS. Jean Causeret and Germain Mocquot

(Centre Nationale de Recherches Zootechnologique, Jouy-en-Josas, France). Ann. Nutr. Aliment., 18: C267-354 (1964). (In French).

Data on the susceptibility of vitamins to various destructive agents, particularly heat, oxygen, light, and ionizing radiation, are given. Thermal treatment of alimentary products, especially pasteurization and sterilization, are discussed, as well as the maintenance of dried and dehydrated products. Conservation of food by ionizing radiation is mentioned. The influence of thermal and radiation treatments on the vitamin strength of the principal classes of food products is reviewed, especially for milk and dairy products, meat and derived products, fish and crustaceans, eggs, fresh vegetables, fresh fruit and derived products, cereals and derived products, and oils. Vitamin losses by various modes of cooking are discussed and the technological aspects and nutritional aspects of industrial thermal treatments are given for most of these categories of foods. The effect of ionizing radiation on vitamin content for each class of product is indicated where known; technological and nutritional aspects are both discussed under this topic as well. Seventeen tables of vitamin contents are included along with four figures, and 177 references are cited. (BBB)

30604 IRRADIATION TECHNOLOGY: READY TO PROCESS FOOD. Atomics, 18: 18-21(May-June 1965).

The current status of food irradiation technology in the U. S. and the world is reviewed. Technology and equipment development, choice of source and facility design, commercial requirements are discussed. (P.C.H.)

30605 MASSIVE RADIATION TECHNIQUES. A. Charlesby (Royal Military Coll. of Science, Shrivenham, Eng.). Chem. Ind. (London), No. 50, 2046-7(Dec. 12, 1964).

A brief review and discussion are presented relating to a series of recent reports on the use of radioactive sources in chemical syntheses, agricultural problems, sterilization of medical products, food preservation, and other applications. An important factor against the use of radiation in chemical industry is the present high cost of radiation. To be economically justifiable it must be used only in chain reactions (as in polymerizations) in high molecular weight compounds, where a large physical change results from a small chemical change, or in the production of valuable products. Only a few new industrial processes, involving the use of radioactive isotopes have been developed. For many chemical purposes, high energy radiation can be considered as a means of producing radicals and ions, under conditions of accurate control, over a range of temperatures, dose rates and in the presence of different environments. Where useful advances have been made with radiation, it is often possible to repeat the results using chemical catalysts, with the advantages of lower investment cost and greater familiarity with conventional techniques of chemical technology. The great advantage of massive radiation techniques appears most clearly when the requirement is to initiate reactions in solid materials, usually in a semifinished stage, and it is here that radiation has become a worthwhile large-scale process, which cannot be easily replaced by conventional chemical methods. However, in such instances the industrial use of radioisotopes is in competition with that of large electrical accelerators, whose installed output must already be equivalent to many million curies of ^{60}Co, and are now used for the radiation-induced crosslinking of polyethylene. In other fields the results have been less successful. It is surprising that so little has been achieved with graft polymers, where the radiation technique has many obvious advantages. Another application of massive radiation techniques considered briefly is the sterilization of medical and pharmaceutical products. This procedure is most suitable for disposable products; the installation of such units at hospitals for resterilization has the difficulty of high initial cost. Since the cost per kw-hr of radiation rises very rapidly as the size of the unit is reduced, it is necessary to step directly from the research scale into large-scale production. (BBB)

30606 STERILIZATION OF MEDICAL INSTRUMENTS WITH GAMMA RAYS. Donald Gould (British Features, Bonn). Elektromedizin, 9: 38-41(Mar. 1964). (In German)

The United Kingdom now has two, and will soon have three, ^{60}Co sources used for the sterilization of medical products such as disposable syringes and surgical sutures. An important advantage of radiation not provided by any other available methods is that an article such as a syringe can be made sterile after it has been assembled and sealed in a package impermeable to microorganisms. Irradiation allows manufacturers to use cheap, easily workable but thermolabile packaging materials like plastics, making it possible to complete assembly and packaging processes under unsterile conditions. The greatest benefit arising from the use of sterilization by irradiation to date has been the provision of the disposable syringe. It is estimated that the National Health Service in Britain could save £1,000,000 each year by adopting disposable syringes for universal use. Plastic syringes are safer and cheaper; they also save time and trouble for the person giving the injection and are ready for instant use in an emergency. Irradiation of packages is carried out in a large cell with massive concrete walls. The ^{60}Co rods are carried from the reactor to the cell in a large lead flask and are pushed from the flask through a port in the concrete wall of the irradiation cell so that they lie in a rack within the cell. The ^{60}Co rack inside the package irradiation cell can be lowered into a pit so that the cell can be safely entered for inspection and maintenance work. Packages to be irradiated are moved through the cell by automatic conveyors. The accepted 2.5-Mrad dose of sterilizing radiation is used. As the ^{60}Co irradiation level decreases, the time of exposure must be increased, and when this time becomes too great the ^{60}Co in the rack is replaced or more added. Several years ago Johnson's Ethical Plastics Ltd. of Slough, England, began to manufacture plastic syringes, and the United Kingdom Atomic Energy Authority sterilized these syringes at the Wantage experimental plant. Having proved the effectiveness of the process, Johnson's established its own ^{60}Co sterilizing unit in November 1962. This was the world's first commercial γ-ray sterilizing plant. In 1963 Ethicon Ltd. opened a similar plant in Edinburgh, Scotland, for the sterilization of sutures. Gillette Industries Ltd. is now building a third plant at Reading, England, for the sterilization of single-use hypodermic needles and syringes. Some problems encountered in irradiation of biologic materials are discussed. (BBB)

30607 DATA ON WHOLESOMENESS STUDIES. A PROGRESS REPORT. Nicholas Raica, Jr. (Fitzsimons General Hospital, Denver). Food Irradiation, 5: No. 3, A2-7(Jan.-Mar. 1965).

Results of studies on the effects of radiosterilization on the wholesomeness of foods are reported. The test food was canned, irradiated to 2.79 and 5.58 MRads, and then fed as 35% (dry solids) in a nutritionally adequate diet after storage at room temperature for at least three months. Canned nonirradiated control food was stored frozen until used. The results showed that goals set in 1953, when the wholesomeness program was outlined, for determining the wholesomeness program was outlined, for determining the wholesomeness of foods irradiated to 5.58 MRad with energies of 1-2 Mev have been reached. Evidence also established that foods irradiated with 11-12 Mev electrons to 5.58 MRad are also wholesome. (P.C.H.)

30608 STUDIES ON FOOD IRRADIATION IN JAPAN. Food Irradiation, 5: No. 3, A8-11(Jan.-Mar. 1965).

Developments in research on radiosterilization of food in Japan during the past 10 years are reviewed. The organization of the council for irradiated food studies and future perspectives is included. (P.C.H.).)

30609 IRRADIATION EXTENDS STORAGE LIFE OF BOMBAY DUCK. Food Irradiation, 5: No. 3, A12-13(Jan.-Mar. 1965).

Packaged Bombay duck fillets were exposed to a radiation dose of 0.4 MRad in a ^{60}Co gamma cell and stored at sub-room temperatures of 10-12°C. The fillets were found acceptable even after 3 weeks storage in respect to flavor, texture, and taste. Under the same storage conditions, untreated fillets were spoiled and unacceptable within 3 days. From total bacterial count taken on the fillets at regular intervals during the storage period it was ascertained that

bacterial spoilage in the irradiated fish was minimal. (P.C.H.)

30610 CAROTENOID CONTENT OF FROZEN AND IRRADIATED SWEET CORN. Doris A. Tichenor, Dudley C. Martin, and Claudia E. Wells (Univ. of Kentucky, Lexington). Food Technol., 19: 106-9(Mar. 1965).

This study was designed to determine the carotenoid content of two varieties of frozen and refrigerated sweet corn and of irradiated sweet corn stored at 35°F for periods up to 280 days. β-Carotene, cryptoxanthin, other carotenoids (diols and polyols), and color were determined in Evertender C and Royal Gold frozen and refrigerated sweet corn exposed to 0.25 to 5.0 Mrad of γ radiation. Frozen samples were stored at 0°F for 4 to 280 days; irradiated and unirradiated refrigerated samples were stored at 35°F for the same periods. Effects of packing in N_2 and with glucose oxidase were investigated. Frozen and refrigerated sweet corn of both varieties contained 0.9–1.3 μg of β-carotene per g, and the amounts were relatively stable during storage. Frozen samples had 1½ to 3½ times as much cryptoxanthin as β-carotene. Packing in N_2 or with glucose oxidase did not substantially improve retention of β-carotene or cryptoxanthin in frozen samples. The biologically inactive diol and polyol fraction comprised 44 to 51% of the total carotenoids of frozen Evertender C, and 41 to 55% of the total carotenoids of frozen Royal Gold. Exposure to radiation affected all carotenoid fractions, with increasing destruction as the dose was increased. Packing in N_2 improved retention of carotenoid pigments in irradiated sweet corn, particularly at the 1.0-Mrad dose level. The effects of irradiation at 0.75 Mrad were pronounced, with 31 to 42% of the β-carotene being destroyed. Increasing the dose to 1.50 Mrad resulted in a 54% loss. No improvement in β-carotene retention was observed in N_2-packed samples irradiated at 5.0 Mrad. Irradiation at this level destroyed 78% of the β-carotene. A radiation dose of 1.50 Mrad followed by storage resulted in destruction of 29% of the cryptoxanthin. The cryptoxanthin content of N_2-packed corn exposed to 1.0 Mrad was the same as that of unirradiated samples, but 37% of the cryptoxanthin in air-packed samples exposed to the same radiation dose was destroyed. Significant additional amounts were lost from air-packed samples during 92 days of storage, and exposure to 3.0 and 5.0 Mrad resulted in further destruction of cryptoxanthin. The diol and polyol fraction in irradiated sweet corn (1.50 Mrad) showed a 45% loss. The diol and polyol content of N_2-packed Royal Gold sweet corn was not significantly lowered by a 1.0-Mrad radiation dose, and remained substantially the same over 192 days of storage. Gardner R_d (brightness) and b (yellowness) readings on cooked and uncooked Evertender C samples were closely related to each other and to values for carotenoid pigments. R_d and b values were highest for unirradiated refrigerated samples, and increasing radiation doses lowered these readings. (BBB)

30611 MEASUREMENTS OF PISTON RING WEAR BY MEANS OF ACTIVATION. Furutama. Genshiryoku Kogyo, No. 11, 54-63(1963). (In Japanese)

To determine piston ring wear, the object to be measured (piston ring, cylinder, etc.) was activated, and the activity of the grease, into which the abraded radioactive material dropped, was measured. A water-cooled four-cylinder gasoline engine was used. Its maximum speed was 4800 revolutions per minute and maximum power, 43 hp. The width and thickness of the piston rings (upper and second) were 2 and 3 mm, respectively, and of the beveled oil-removable rings, 4 and 3 mm. The exhaust gas, which contained oil with radioactive particles from the pump and could be burned, went through a flexible, seamless stainless steel pipe to a heat exchanger, was cooled to 50°C, and vented. The temperature of the water at the heat exchanger exit was 80°C. The cooled oil was pumped from the crankcase to the activity detector (scintillation counter) and then returned to the crankcase. Special instruments and remote operation were used to prevent over-exposure of personnel to radiation while changing the piston ring or oil. Measurements of chromium and iron radioactivity ratios to determine the mechanism of the wear process showed the wear rate to be very high at the moment of startup. The wear rate increased with increased speed or load, but never was as great as at startup, and was very low when the cooling water at the outlet was 25°C instead of 80°C. (P.C.H.)

30612 UTILIZATION OF IONIZING RADIATION (^{60}Co) FOR THE PROTECTION OF FOODSTUFF AGAINST HARMFUL INSECTS. INVESTIGATIONS RELATIVE TO THE DETERMINATION OF THE MINIMUM DOSE USABLE TO ASSURE THE STERILITY OF THE INSECTS. P. Pesson (Institut National Agronomique, Paris). Ind. Aliment. Agr. (Paris), 80: 211-25(Mar. 1963). (In French)

The minimum sterilizing dose for Sitophilus granarius L., Sitophilus oryzae L., Tribolium confusum, Gnathocerus cornutus F., Rhizopertha dominica 01., Acanthoscelides obsoletus, Ephestia kuhniella Zell., and Sitotroga cerealella 01. was investigated. The radiosensitivity of the eggs, larva, nymphs, and adults was determined for each species at doses from 2000 to 34,000 R. The results are tabulated. Generally it was established that the eggs and the young larva are more sensitive than the old larva or the nymphs and these are more sensitive than the adults. (J.S.R.)

30613 RADIOISOTOPES IN THE TEXTILE INDUSTRY. Wiehart, H. Melliand Textilber., 45: 187-90(Feb. 1964). (In German)

Radioisotopes are being used widely in textile production for analytical investigations, testing of materials, measurement and control, and altering of materials through ionizing radiation. Activation analysis, attenuation analysis, and radioreagent methods are illustrated by examples taken from the textile technological laboratory. Radioisotopes are used for examining the durability of finishing (sizing) materials; e.g., materials are labeled with ^{14}C and the loss in activity after repeated washing and drying of the impregnated fabric is determined radiometrically. Radioactive "dirt," labeled with ^{32}P compounds, is often used to measure the efficiency of washing materials. In the foulardation process where textiles are prepared for subsequent printing, the absorbing capacity and homogeneity of absorption are determined by using water-soluble ^{32}P-labeled phosphates. Absorption and backscattering β gages are used widely. ^{85}Kr, ^{137}Cs, and ^{90}Sr, used for very light, medium heavy, and very heavy fabrics, respectively, determine thickness with great precision. Elimination of static electricity in textile processing by ionizing the air with X- or β-emitters (e.g., ^{204}Tl) is mentioned. The effects of radiation on textile materials and synthetic fabrics are discussed. (OID)

30614 INVESTIGATION OF LARGE SCALE USE OF RADIOACTIVE KRYPTON-85 FOR LEAK DETECTION IN THE SATURN SPACE VEHICLE. L. E. Brownell, M. A. Farvar, G. L. Gyorey, and M. York (Univ. of Michigan, Ann Arbor). Nucl. Struct. Eng., 1: 492-9(May-June 1965).

A method was developed for leak detection in space vehicles during factory test and checkout prior to launching and space flight. The long-range objective of a versatile leak detection system that could be used in space, during launching, as well as during static testing, was kept in view. A leak detection technique was developed based on the use of ^{85}Kr as a radiotracer. This technique is considered more versatile than others. Krypton has sufficient solubility to be used as a tracer in all liquids tested, except hydrogen. Leakage rates can be determined with greater precision, in the order of 0.005 SCIM (standard cubic inches per minute), than by any other methods. Because of safety and ease of use, ^{85}Kr shows promise for many applications. (auth)

30615 CHRONIC TOXICITY STUDIES ON IRRADIATED BEEF STEW AND EVAPORATED MILK. J. L. Radomski, William B. Deichmann, B. S. Austin, and William E. MacDonald (Univ. of Miami, Coral Gables, Fla.). Toxicol. Appl. Pharmacol., 7: 113-21(Jan. 1965).

As part of a large-scale, nationwide toxicologic effort to evaluate the toxicologic hazard possibly associated with the sterilization of food by γ radiation, the effects of irradiation sterilization on the toxicity of canned beef stew (C-ration) and evaporated milk were studied. Two levels of irradia-

tion, 2.79 and 5.58 Mrad, were tested. Even the 2.79-Mrad level was well above the level needed for sterilization. To further increase the margin of test level over intended use level, and thus the severity of the test procedure, a maximum tolerated percentage (35% of the total dry solids) of the test material was incorporated in the diet of rats and dogs. Over the two-yr course of the experiment biochemical and hematologic studies were performed, and when the animals were sacrificed their tissues were subjected to gross and histopathologic examination. Breeding experiments were also carried out. The mean food consumption, weight gain, feed efficiency, and the mortality of the first generation rats fed irradiated beef stew and irradiated evaporated milk showed no significant differences. The results of breeding and lactation performance studies of the rats fed irradiated beef stew and evaporated milk were also entirely negative. The feeding of irradiated beef stew or evaporated milk to rats for two yr did not produce histopathologic tissue changes in rats. In dogs food consumption and weight gain were lower in the evaporated milk than in the beef stew experiment, apparently related to the greater palatability of the beef stew diet, but no differences were observed between the dogs fed the control and irradiated diets. Feeding dogs the irradiated diets had no effect on the number of pups whelped or weaned, or on the weights of the pups. The tissues of all dogs fed both the irradiated and the nonirradiated evaporated milk were normal with the exception of one dog fed 2.79-Mrad irradiated evaporated milk which had chronic pneumonia and enteritis with hyperplasia of the Peyer's patches. However, it was apparent that the feeding of either irradiated beef stew or evaporated milk to dogs produced no significant histopathologic changes attributable to the diet, and it is concluded that there was no indication of any toxic effect due to the feeding of either irradiated food either in the longevity or the breeding phases of these experiments. (BBB)

30616 MEASUREMENTS OF HUMIDITY WITH NEUTRONS AND LIMITS OF APPLICATION. V. Schuricht. Thesis, Dresden, Technische Universitat, 1964. 138p. (In German). $2.00 (Gmelin, AED-DISS. 64-324).

Various techniques for humidity measurements are reviewed. Sources of errors in the neutron method are discussed. (137 references) (Gmelin Inst.)

30617 THE INCREASING OF THE X RAY SENSITIVITY OF CdS CELLS BY ADDITIONAL CONTINUOUS ILLUMINATION AND SOME EXAMPLES OF TECHNICAL APPLICATIONS. H. Franz. Thesis, Freiberg/Sachsen, Ger., Bergakademie, 1962. 64p. (In German). $2.00 (Gmelin, AED-DISS. 62-721)

Sensitivity of CdS cells for x rays can be increased about one order of magnitude by illumination with continuous light. In addition the individual properties of CdS cells can be compensated by this method. Technical applications in level and quality control are discussed. (Gmelin Inst.)

30618 IMPROVEMENTS IN OR RELATING TO TRANSFER MECHANISMS FOR OVERHEAD RAILWAYS IN PACKAGE IRRADIATION PLANTS. Sidney Jefferson, Frank Rogers, John Francis Milson, and Ernest Robert Landon (to United Kingdom Atomic Energy Authority). British Patent 982,691. Feb. 10, 1965. Filed May 25, 1960.

A package irradiation plant includes an irradiation cell and a railway for conveying material carrying containers through the cell. The railway is made up of a series of discrete portions of rail track substantially parallel to each other, a moveable member to which a short section of track is attached, and means by which the transfer member is moved to align the short section of track with any of the discrete portions. The transfer member is suspended from fixed overhead supports by spaced tension members so that the member will tilt upwards the end of the short track adjacent to the discrete track. The short section of track may be moved in two ways: first, through a curved path to align first with one track portion and then another by the transfer member being constrained to arcuate movement by horizontal cranks, and secondly, along a cyclodial path by a wheel eccentrically journalled on the movable member. The rim of the wheel engages a suitable track to rotate without slip when the moveable member is moved transversely relative to the length of the portion of rail track forming the series. The ends of the tracks may be provided with inclined planes to control the movement of the trolleys. (B.L.M.)

30619 METHOD FOR TESTING THE PENETRATION OF MATTER INTO BODIES. (to Consolidated Electrodynamics Corp.). British Patent 992,972. May 26, 1965. Filed Jan. 26, 1960.

A method is described for testing a body for penetrability by fluidic matter such as a mixture of one part krypton-85 and 100 parts by volume of nitrogen to yield high-energy beta radiation. The body to be tested is immersed in a supply of the fluidic matter. If the hollow body is leaky, some of the fluidic matter penetrates the body and gives rise to electromagnetic or high range radiation that can be detected by known instruments after the body is removed from the fluidic matter. Decontamination of the external surface of the body prior to detection will increase the accuracy of the radiation detection. (B.L.M.)

30620 APPARATUS FOR IRRADIATION OF A MATERIAL WEB. Willy Roth (to Texfico Ltd.). Canadian Patent 683,390. Mar. 31, 1964. Priority date Apr. 14, 1960, Switzerland.

A method and apparatus are described for treating material webs with ionizing radiation, preferably gamma rays emitted by sources such as ^{60}Co and ^{137}Cs. The term web is used to include fabrics, tapes, paper, cast and rolled sheets, filaments and yarns, or any other material capable of being wound in superposed layers on a spool or reel. While the material is being wound on a hollow reel, it is subjected to radiation from an elongated source positioned generally centrally, preferably axially, of the reel. If desired, the treatment may be continued while the web is being unwound from the reel. The reel may also be subjected to additional radiation during the winding and/or rewinding from a secondary or auxiliary source that is positioned adjacent but exteriorly of the periphery of the reel. (B.L.M.)

Power Application

30621 (MND-3169-18) DYNAMICS AND LOADS ANALYSES OF SUPPORT STRUCTURE FOR SNAP-19 GENERATORS (NIMBUS APPLICATION). B. T. Bata and R. S. Buxbaum (Martin Co., Baltimore, Md. Nuclear Div.). Aug. 1964. Contract AT(30-1)-3169. 46p. Dep.(mn); $2.00(cy), 2(mn) CFSTI.

A three-dimensional structural dynamics analysis was carried out to evaluate the design of the generator support structure. The various configurations analyzed are described. Results (frequencies, internal loads, deflections, and reactions at satellite interface) are given in detail for the final configuration. (D.L.C.)

30622 (MND-3169-21) SNAP-19 PROGRAM ELECTRICAL INTEGRATION CONCEPTUAL STUDY. M. Monaco and C. Karr (Martin Co., Baltimore, Md. Nuclear Div.). June 1964. Contract AT(30-1)-3169. 42p. Dep. (mn); $2.00(cy), 1(mn) CFSTI.

Several combinations of 30 and/or 60 watt converters and the 30 generators, with auxiliary switching and sensing units as required, were analyzed for potential efficiency, reliability, and weight characteristics. A configuration was selected which involved the use of two 30 watt generators in combination with two converters with a 60 watt capacity. Two generator-converter systems are paralleled to provide a 60 watt package. Appropriate switching and sensing elements provide the capability for an external A/D converter system to signal removal of a failed converter unit from the system. It became apparent that any consideration of the relative merits of any redundant configurations must include the effect of the reliability of the external A/D converter system. Below a reliability of 0.97 for the A/D converter, for a 1 year mission time, there is no

overall advantage in providing redundant characteristics in the power system configurations. (auth)

30623 (MND-3169-60) SNAP-19 PROGRAM GENERATOR PROTOTYPE QUALIFICATION ENVIRONMENTAL TEST REPORT ELECTRICALLY HEATED SYSTEM NO. 2. PART I. HUMIDITY AND DYNAMIC TESTS. C. L. Riggen (Martin Co., Baltimore, Md. Nuclear Div.). Apr. 1965. Contract AT(30-1)-3169. 67p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Results are reported of design qualification tests which were conducted on a SNAP-19 prototype thermoelectric generator. The generators exhibited acceptable characteristics and performance to meet all prototype qualification requirements under environments of humidity, vibration, and acceleration. The structural integrity of the support structure and its ejection mechanism was demonstrated during all test exposures. (D.L.C.)

30624 (MND-3169-61) SNAP-19 PROGRAM GENERATOR SUPPORT STRUCTURE TRANSMISSIBILITY TEST REPORT. G. N. Numsen (Martin Co., Baltimore, Md. Nuclear Div.). Apr. 1965. Contract AT(30-1)-3169. 118p. Dep.(mn); $4.00(cy), 4(mn) CFSTI.

Results are presented of transmissibility tests conducted on the generator and support structure assembly of the SNAP 19 Radioisotope Thermoelectric Generator power supply system for the Nimbus B Satellite application. Transmissibility data is presented in the form of response vs frequency plots for various locations and vibration conditions. (auth)

30625 (MND-P-2358) NUCLEAR SAFETY TEST REPORT FOR THE SPACE VERSION OF THE PRESENT SNAP-III THERMOELECTRIC GENERATOR. T. J. Dobry, Jr. (Martin Co., Baltimore, Md. Nuclear Div.). June 1960. Contract AT(30-1)-2358. 101p. Dep.(mn); $4.00 (cy), 2(mn) CFSTI.

Results and conclusions are presented of an experimental program conducted to evaluate the nuclear safety of a space version of the thermoelectric generator. After the definition of a space safety design criterion, general design changes and detailed test specimen specifications are given. Two generator configurations and a re-entry burnup fuel core design were subjected to a high-velocity impact test, a mechanical shock test, and a missile fire test. (D.L.C.)

30626 RADIOACTIVE ISOTOPE POWERED THERMOELECTRIC GENERATOR SYSTEM. Joseph H. Vogt, Charles N. Young, and Willard C. Reed (to U. S. Atomic Energy Commission). U. S. Patent 3,192,069. June 29, 1965.

The invention relates to a hydraulic mechanism to regulate the temperature of a radioactive isotope powered thermoelectric generator and thus control the electrical output over the life of the fuel. The mechanism utilizes a differential pressure bellows and piston arrangement to transmit motion to a thermal shutter, one side of said bellows and piston arrangement being connected to a constant pressure source and the other side being connected to a temperature sensitive working fluid proximate to said isotope. (AEC)

Separation and Production

See also CHEMISTRY — Separation Processes and Procedures.

Refer also to abstract 30435.

30627 (BNL-9166) PREPARATION OF USEFUL BUT PRESENTLY UNAVAILABLE ISOTOPES. L. G. Stang, Jr. (Brookhaven National Lab., Upton, N. Y.). May 3, 1965. Contract AT-30-2-GEN-16. 18p. (CONF-641216-1). Dep. (mn); $1.00(cy), 1(mn) CFSTI.

From IAEA Study Group Meeting on Research Reactor Utilization, Trombay, India.

A brief discussion is given of progress in isotope production in reactors at Brookhaven. Among the topics discussed are the effects of ^{132}Te oxidation states on yields from a ^{132}I generator and the oxidation states of the iodine, radiotellurium isomer generators, improved product purity from ^{99m}Tc generators, production of ^{28}Mg by ^{26}Mg(t,p) reaction and of ^{58}Co by ^{56}Fe(t,n) reaction, ternary fission of ^{235}U, and colloidal ^{99m}Tc. (D.L.C.)

30628 (CEA-Bib-46) EFFET ISOTOPIQUE DANS L'ADSORPTION PHYSIQUE. (Isotopic Effect in Physical Adsorption). Courvoisier, Pierre (Commissariat à l'Énergie Atomique, Saclay (France). Centre d'Études Nucléaires). Mar. 1965. 23p. Dep.(mn).

This literature review covers the period from 1933 to 1962 and includes 31 references. In the first part, are presented the hypotheses, the models, and the calculation methods leading to a determination of the theoretical separation factor in the case of mono- and di-atomic molecules. In the second part, a review is made of the experimental results obtained for the isotopes of hydrogen, neon, nitrogen, and argon; these results are then compared with the theoretical predictions. (auth)

30629 (MLM-1238) MOUND LABORATORY PROGRESS REPORT FOR JANUARY 1965. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). Jan. 29, 1965. Contract AT(33-1)-Gen-53. 38p. Dep.; $2.00(cy), 1(mn) CFSTI.

The alpha phase of the isotopic mixture of polonium-208/209 metal was stabilized and isolated by continuous cooling using He gas refrigerated by passage through liquid N_2. X-ray-diffraction patterns were indicative solely of alpha Po in space group O_h^1-Pm3m, possessing a lattice parameter of $a_0 = 3.359$ Å. PoS and PoO_2 were prepared for structure determination by x-ray powder methods. ^{232}U contamination of ^{234}U recovered from aged Pu samples may have been present originally either as ^{236}Pu or ^{232}U. Calculations showed that the rate of growth of short-lived daughters of ^{232}U depends upon whether the parent isotope was ^{236}Pu or ^{232}U. Gamma counting of the 2.6-Mev photopeak of ^{208}Tl in two ^{238}Pu samples for one month demonstrated that the predicted differences are measurable. The best present half-life value for ^{238}Pu was determined as 87.60 years with a probable error of ±0.06 year. After 195 days and 29 observations, the method of decaying pairs yields a half-life value for ^{210}Po of 138.55 ± 0.04 days. The increase in the neutron yields of ^{238}PuBe sources was measured with the precision long counter for three sources: M-591, M-977, and M-1045. The agreement for predicted and measured growth rates is poor for one of the sources—M-1045. Cascade performance calculations were made for the existing CH_4 thermal diffusion system and for a planned expanded system of 30 columns. ^{13}C production rates of 0.042 and 0.108 g/day were calculated for the old and new systems, respectively. A separation factor of 1.25 was observed in experiments with carbon dioxide-monoethanolamine chemical exchange column. Results using Ca at 650°C to prepare high-purity ^{3}He showed a tenfold tritium reduction in ^{3}He to about 10^{-9}%. Flow rates for four columns in the Ne thermal diffusion cascade were adjusted to avoid depletion of ^{21}Ne. Concentrations of ^{20}Ne and ^{22}Ne are above 99.8%. The 1.8 ml/hr product rate of ^{36}Ar moved the ^{38}Ar peak toward the fourth stage of the 11-stage thermal diffusion column system. The rate was reduced to 1 ml/hr, and the ^{38}Ar peak is moving downward. Localizing this peak at the bottom of the third stage is planned. A modified feed method is being used in the thermal diffusion enrichment of ^{86}Kr. Fresh feed was added to bring the system to operating pressure without removing the old feed. The product contained slightly less ^{86}Kr than the product of the previous runs. The six-stage, cascaded thermal diffusion system with two swing units has lowered the ^{131}Xe content in the product to 0.44%. This value is the best obtained to date. Values for the heats of adsorption of Kr and Xe on activated charcoal are −2.79 and −5.02 kcal per mole, respectively. Several molecular beam-scattering runs using the prototype single-beam production apparatus were made. Inconsistent data points were obtained due to mismatched outputs. A complete set of thermal diffusion column transport coef-

ficients was obtained for $^{20}Ne-^{22}Ne$ separation in a 6-ft experimental column. The parasitic remixing coefficient was measured for $^{20}Ne-^{22}Ne$ separation in 12-ft experimental columns. For 15% center-wire misalignment, the parasitic effect was slightly larger than the normal convective remixing effect. Measurements of static separation versus pressure were made for $^{3}He-^{4}He$ in 12-ft experimental thermal diffusion columns. Good agreement with theory was found. Unresolved discrepancies exist between the various data on thermomolecular pressures in He. Experiments with saturated ^{4}He at 1.2 to 0.8°K yielded values that were high compared with values calculated using the Weber-Schmidt equation. Preliminary investigations of a polarographic procedure for the simultaneous determination of Pb, Sn, and In in solder indicate the constituents may be analyzed with average deviations of ±0.7, ±0.5, and ±0.1%, respectively. The time required for an analysis after sample dissolution is approximately 30 minutes. A discrepancy between analytical and expected results is being investigated. In analysis for O by 14-Mev neutron activation the samples are loaded in dry, inert atmospheres, irradiated for 10 sec, and counted for 30 sec. The ^{16}N produced has a gamma energy of 7.10 Mev. There is only one interference (F) occurring at this energy; it can be detected and subtracted if present. (J.R.D.)

30630 (MLM-1245) MOUND LABORATORY PROGRESS REPORT FOR FEBRUARY 1965. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). Feb. 26, 1965. Contract AT(33-1)-Gen-53. 26p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Radial distribution curves of alpha and beta phases of polonium-208/209 metal were computed on a relative basis. Po–Po interatomic distances for the alpha phase occurred at 3.5 Å; the nearest neighbor distance in the beta phase was at 3.4 Å. The octahedral configuration of six Po atoms surrounding the central Po atom was depicted by the octahedral edge distance at approximately 4.8 Å. After 229 days and 32 observations, the method of decaying pairs yields a half-life value for ^{210}Po of 138.46 ± 0.03 days. Twenty milligrams of ^{227}Ac were purified. The material was determined to be 100% radiochemically (chain) pure and 95% chemically pure. Gamma counting of two ^{238}Pu samples was continued in an effort to determine the parent isotope of the hard gamma impurities. The data showed that one sample contained some initial ^{236}Pu. Anomalous results were obtained for the second sample, and no conclusions could be drawn. A CO_2-carbamate chemical exchange run with a new decomposer was comparable, in the early stages, with published experimental results for this system. Parasitic circulation and solvent loss sharply reduced the separation. Localizing the ^{38}Ar peak at the middle of the cascade has slowed the ^{38}Ar transport. The ^{36}Ar product rate was increased to shift the ^{38}Ar peak toward the top of the cascade and to increase the transport. The six-stage cascaded thermal diffusion system with the modified Trennschaukel gas circulating system lowered the ^{131}Xe content in the product to 0.39%, the lowest concentration to date. The heats of adsorption for Xe and Kr on charcoal and on silica gel were determined by gas chromatography. The values for Kr and Xe on charcoal were −2793 and −5025 cal/mole, respectively. The values for Kr and Xe on silica gel were −2045 and −3812 cal/mole, respectively. Approximately 10 g of O_2 depleted to 0.02% in ^{17}O and ^{18}O, were prepared in the 12-ft tube bundle prototype thermal diffusion column. This material will be used for (α,n) studies. Separation factor versus flow rate data were obtained for $^{20}Ne-^{22}Ne$ in two columns and for $^{3}He-^{4}He$ in a third column. The data for Ne were used to calculate transport coefficients. To obtain accurate values of α_T(thermal diffusion factor) for isotopic mixtures, a simplified experimental procedure was devised whereby large separations can be obtained; thus values of α_T can be obtained for low temperatures, and the assignment of α_T can be made to specific temperatures. In the vapor pressure thermometry experiments data were obtained for unsaturated ^{3}He gas. The values were in agreement with previous data for unsaturated ^{4}He gas. The lucite irradiation chamber of the Be gamma activation analysis facility was redesigned and a motor was added to rotate the sample during irradiation. A more thorough study was made on the counting characteristics of the ^{3}He-filled tubes. The analysis now takes 15 to 30 min and has a standard deviation of ±0.18% at a 95% confidence level. A method for the determination of impurities in Pu residue samples was developed. The technique, using emission spectroscopy, involves the use of an $Ar-O_2$ atmosphere which minimizes the background and enhances the sensitivity of selected lines. Pure Ar was found to be undesirable as the inert atmosphere. An Al block calorimeter was fabricated for measuring heats of polymerization of several polymers at −20 to +50°C. The reactants are mixed by a stirrer which is used to break a glass bulb containing one of the reactants. Single-crystal silicon carbide thermistors are used for the temperature measurements in the device. Techniques are being developed for preparing and reworking semiconductor radiation detectors. Si-barrier detectors were prepared with resolutions of the order of 2.5% (FWHM) for 4.88-Mev alpha particles from ^{209}Po. Alpha groups from a mixture of polonium-208, -209, and -210 at 4.88, 5.11, and 5.30 Mev are resolved completely. (J.R.D.)

30631 (MND-3137) RADIOISOTOPES PILOT PLANT, QUEHANNA, PA. FACILITY DESIGN AND SAFETY EVALUATION. C. O. Riggs, T. W. Conway, and L. K. Clark (Martin Co., Baltimore, Md. Nuclear Div.). Apr. 1964. Contract AT(30-1)-3062. 285p. Dep.(mn); $6.00 (cy), 5(mn) CFSTI.

After a description of the site, plant, process, etc., a general safety evaluation is made of the facility and its operation. This evaluation is in support of an application for license to continue processing multi-Curie quantities of strontium-90 for use as heat source. (D.L.C.)

30632 (ORNL-3815) REVIEW OF ORNL THERMAL DIFFUSION PROGRAM, JANUARY–DECEMBER 1964. Butler, T. A.; Rathkamp, W. R.; Greene, H. B. (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 25p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

This review includes column operation, methods of increasing the feasibility of isotope separation of inert gases by thermal diffusion, and product enrichments. The past year's efforts were concentrated on the separation and enrichment of particular isotopes of the inert gases — neon, argon, krypton, and xenon. Chrome-plated columns to minimize heat losses due to radiation from the heaters and conduction through specially designed spacers holding the heating element and preenrichment of feed material were investigated through theoretical developments. Feasibility of these methods was tested and compared to theoretical evaluations by data obtained from actual operating conditions. (auth)

30633 (RL-SA-16) CLEAN URANIUM-233. W. K. Woods (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Feb. 1, 1965. Contract AT(45-1)-1350. 9p. (CONF-650402-1). Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

From American Society of Certified Engineering Technology, Richland, Wash.

The preparation and uses of "clean" ^{233}U (i.e., ^{233}U containing very little ^{232}U) are outlined. (T.F.H.)

30634 RAPID CHEMICAL SEPARATION OF ISOMERIC STATES OF LANTHANIDES. T. Stenstroem and B. Jung (Uppsala Univ.). Radiochim. Acta, 4: 3-6(May 1965).

An extraction method was developed for separation of short-lived isomeric states of lanthanides. The method was based on the chemical decomposition of lanthanide phthalocyanine molecules following nuclear transformation of the central metal atom, and allowed the separation of 11-min ^{158g}Ho from 27-min ^{158m}Ho, 26-min ^{160g}Ho from 5.0-hr ^{160m}Ho, 6.8-s ^{161m}Ho from 3.1-hr ^{161}Er, and 15-min ^{162g}Ho from 68-min ^{162m}Ho. Because of the chemical similarity of the lanthanides, there were reasons to believe that the method should also work for other lanthanide nuclides. A continuous separation in which the transformed nuclei migrate from a finely dispersed solid phthalocyanine phase to a moving liquid phase was also

studied. This method appears to allow separation of nuclides with half lives of the order of 1 sec. (auth)

30635 SIMPLIFIED SHAPE FACTORS FOR A THERMAL DIFFUSION COLUMN. C. J. G. Slieker (F.O.M.-Laboratorium voor Massascheiding, Amsterdam). Z. Naturforsch., 20a: 521-6(Apr. 1965).

Starting from Cohen's theory of square cascades and countercurrent separation processes, column constants for the three types of thermal diffusion columns are calculated. It is assumed that the transport coefficients may be regarded as constants, whereas their values are taken at the mean temperature in the column. By comparison with other theories and experimental results the simplified theory appears to be as good as the more refined ones. (auth)

30636 SEPARATION OF ISOTOPES IN THE REGION OF DISSOCIATION. W. Frie (Siemens-Schuckertwerke AG, Erlangen, Ger.). Z. Physik, 185: 493-506(1965). (In German)

Regarding the dissociation energies of isotopes to be equal, the mass separation of two isotopes along the gradient of temperature in the region of dissociation is treated theoretically. In this system there seems to be a disagreement: The separation effect does not vanish, when corresponding particles are identified. An explanation is given for this observation. (auth)

30637 METHOD FOR PRODUCING, SEPARATING, AND PURIFYING PLUTONIUM. Glenn T. Seaborg, Arthur C. Wahl, and Joseph W. Kennedy (to U. S. Atomic Energy Commission). U. S. Patent 3,190,804. June 22, 1965.

A process is described for producing plutonium from a mixture of ^{238}U and a fissionable isotope of uranium by subjecting the mixture to a self-sustaining neutronic chain reaction and aging both for a time long enough to obtain a transuranic fraction containing at least 90% of plutonium and isolating the plutonium. (AEC)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 31459 and 31461.

30638 (ANL-6993) WHADDAYADOO WITH THE DIDJERIDOO? A Generalized ASI-2100 Program for Handling Data from the ND-160 Pulse-Height Analyzer. D. S. Gemmell (Argonne National Lab., Ill.). Jan. 1965. Contract W-31-109-eng-38. 53p. Dep.; $3.00(cy), 1(mn) CFSTI.

DIDJERIDOO is a flexible program for handling data acquired in tandem Van de Graaff experiments. The program utilizes the ND-160 pulse height analyzer and the PHYLIS computing system. (T.F.H.)

30639 (LADC-6484) COMPARISONS OF SOME TWO-STAGE SAMPLING METHODS. Aaron S. Goldman (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1963]. Contract [W-7405-eng-36]. 11p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

Several two-stage methods are available to determine how large a second sample should be taken so that either an estimate of a parameter has a specified variance or a $(1-\alpha)$ confidence interval placed on a parameter has a specified width. A computation for the expected sample size in Graybill's method applied to estimating the mean and variance when sampling from a Normal population is presented. Assistance may then be had in obtaining the first sample. Tabular comparisons are also made where feasible with the techniques of others. Brief explanations of three methods, which were chosen mainly because of their relative ease of computation, are given. (P.C.H.)

30640 (SC-R-64-1386) TABLE OF ARC SIN $x/2\pi$, (d/dx) ARC SIN x, AND ARC SIN (k/n). D. E. Amos, D. B. Owen, and G. P. Steck (Sandia Corp., Albuquerque, N. Mex.). Dec. 1964. Contract AT(29-1)-789. 164p. Dep.; $5.00 (CFSTI).

Tables are given of (arcsin x)/2π, (d/dx)(arcsin x)/2π, arcsin x, arccos x, (arccos x)/2π, arcsin k/n, (d/dk) (arcsin k/n), (arcsin k/n)/2π, (d/dk)(arcsin k/n)/2π, arccos k/n, and (arccos k/n)/2π, for $x = 0.0001(0.0001)$ 1.0000 and for $x = k/n$ with $1 \leq k < n \leq 100$. (T.F.H.)

30641 (TID-17042(p.64-71)) MATHEMATICAL ANALYSIS AND MACHINE COMPUTATIONS. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.).

An IBM 7040 program (CONPLT) is described that generates contour maps of neutron flux from the diffusion code PDQ-40. An inventory-control program is described. A program is developed to analyze gamma spectra by least-squares determination of both intensities and energies of component spectra. Several data-analysis programs are noted. (T.F.H.)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 30339 and 31462.

30642 (BMI-1707(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING DECEMBER 1964. Russell W. Dayton and Stan J. Paprocki (Battelle Memorial Inst., Columbus, Ohio). Jan 1, 1965. Contract W-7405-eng-92. 47p. Dep.; $1.25(cy), 2(mn) CFSTI.

Research and development are reported on reactor materials and components, reactor fuels, radioisotope and radiation applications, fluoride volatility process corrosion, gas-cooled reactors, and small radioisotopic power sources. (J.R.D.)

30643 (BNWL-30) PRECIPITATE PARTICLES IN DILUTELY ALLOYED URANIUM QUANTITATIVE METALLOGRAPHY. K. N. Woods, Y. E. Smith, and R. D. Leggett (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1965. Contract AT(45-1)-1830. 40p. Dep.; $2.00(cy), 1(mn) CFSTI.

An electrolytic etching technique for delineating the precipitated second-phase in unirradiated dilute uranium–iron–silicon alloys was investigated. Particles revealed in 15000X electron micrographs of negative replicas were measured on a Zeiss Particle Size Analyzer. This information was used to estimate the total density, volume fraction, and size distribution of the precipitate particles. Three independent methods of calculation were applied to determine the distribution curves. These studies lead to the following conclusions: The etching technique shows promise for delineating second-phase precipitate particles of 0.1 to 1 μ in dilute alloys of uranium. A U–180 ppm Fe–90 ppm Si alloy reacts to solutionizing and precipitation treatments in accordance with established theories and published solubility data. The peaks of the particle size distributions of some specimens can only be revealed by reducing the resolution point from approximately 0.1 to 0.02 μ or less. Additional developmental effort is required to apply the etching techniques to irradiated uranium. The three numerical methods used to analyze the particle size data yielded similar but not identical three-dimensional distributions. Selection of the most suitable method requires additional study. (auth)

30644 (BNWL-48) REACTION OF HYDROGEN WITH NIOBIUM AND TANTALUM IN THE ATR GAS LOOP. Charlot L. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1965. Contract AT(45-1)-1830. 18p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Literature on the H–Nb and H–Ta systems is reviewed with respect to possible hydrogen embrittlement of these two metals in the ATR gas loop. It is concluded that hydrogen will probably not influence the mechanical properties of Nb or Ta in the ATR loop. (D.L.C.)

30645 (EUR-1819.e(p.105-44)) THE APPLICATION OF X-RAY PROJECTION MICROSCOPY TO THE QUALITY CONTROL AND INSPECTION OF COATED PARTICLE FUELS FOR THE DRAGON REACTOR EXPERIMENT. J. F. G. Conde (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

After a description of the Dragon reactor fuel, the problem of assessing the coated fuel particles is considered. The x-ray projection microradiographic procedure which was established for the routine examination of Dragon coated-particle fuels is outlined, and the observed features are described. (D.L.C.)

30646 (GEMP-46A) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 46, PART A. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Apr. 15, 1965. Contract AT(40-1)-2847. 31p. Dep.; $2.00(cy), 1(mn) CFSTI.

Krypton was concurrently dissolved and diffused in Ta cathode samples which were self-resistively heated to 1730°C while under glow discharge for different exposure times and Kr pressures. These diffusion specimens are being sectioned in 400-Å-thick increments to determine the Kr concentration distribution. A mathematical model for calculating diffusion coefficients is being developed. Heat-soaking treatments on two evacuated arc-cast Ta cans were continued to 125 and 150 hours, respectively, at 2400 to 2450°C under a pressure differential of approximately 0.8 atm of Kr; the upper limit permeation coefficient at 2400°C was lowered to 4×10^{-15} cm^3 (STP)-mm/cm^2-sec-cm Hg for Kr permeation through Ta. Extrapolation of the fuel retention data at 1200°C in air from 5,000 to 15,000 hours indicates that BeO-base fuel elements containing 7 to 25 vol. % UO_2-ThO_2 and $UO_2-ThO_2-Y_2O_3$ would lose less than 1% UO_2. Based on fuel loss and nonnuclear thermal stability, the potential operating lifetime of these fuel elements appears slightly less at 1400°C than at 1200°C. BeO-coated BeO-base fuel elements containing $UO_2-ThO_2-Y_2O_3$ compositions demonstrated better thermal stability than any other known homogeneously fueled BeO elements. Examination of specimens irradiated to dosages of 2.5 to 3×10^{21} nvt (≥1 Mev) at 1000°C showed that specimens of 5- and 10-micron grain sizes had high strength even though the volume expansion was 1.7 to 2.0%. Strength increases ranged up to 40% greater than the pre-irradiation values. Some microcracking occurred in the EBOR composition and in AOX specimens of 20-micron grain size which expanded 2 to 3%; the strength of these materials was 60 to 70% of the pre-irradiation value. Elastic constant and open porosity measurements, He analyses, and electron micrographic observations were made of these specimens. (J.R.D.)

30647 (HW-84573) METALLURGY RESEARCH OPERATION. Quarterly Progress Report, October–December 1964. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Jan. 15, 1965. Contract AT(45-1)-1350. 155p. Dep.; $5.00(CFSTI).

Research is reported in sections on physical metallurgy, reactor metals research, chemical metallurgy, and materials engineering. Separate abstracts were prepared for each section. (J.R.D.)

For abstracts of individual sections see: 30648, 30649, 30669, and 30737.

30648 (HW-84573(p.3.1-74) PHYSICAL METALLURGY. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Mo foils irradiated to 10^{20} nvt contain defect clusters associated with complex interconnecting dislocation networks and rings, which at this irradiation level are independent of C concentration. The dislocation rings have Burgers vectors a/2 ⟨111⟩ and lie on {111}. The lattice parameter of polycrystalline Mo undergoes a decrease in the exposure range of 10^{19} to 10^{20} nvt, but the x-ray linewidth continues to increase. Annealing of polycrystalline Mo irradiated to 10^{20} nvt results in recovery of line width, but not lattice parameter. The effective activation volumes, V^*, for unirradiated and irradiated (1×10^{17} and 1×10^{18} nvt) Mo were determined from strain-rate change experiments conducted at several temperatures, and the effect of postirradiation annealing was investigated. V^* increases with temperature from a value of $10b^3$ at 295°K, and for low strains, V^* is much higher in the irradiated specimens. Annealing at 550 and 875°K restores V^* to the unirradiated value; annealing at 460°K only partially restores it. Slip lines formed on the surface of single crystals of high purity Mo which had been bent after irradiation to 10^{19} nvt were correlated with channels observed in the crystal by transmission microscopy. Studies on similar crystals, which contained approximately 450 ppM C, showed that slip line density is higher in the crystal containing C. The effects and interactions of burnup, burnup rate, tempera-

ture, external pressure, composition, metallurgical state, and geometry on the behavior of U during capsule irradiations were investigated. Examination of specimens irradiated in controlled temperature capsules corroborates that alloy additives of Fe + Si and Fe + Al reduce the swelling of U. The stability of U + Fe–Al specimens is superior to U + Fe-Si specimens. Postirradiation density values of high-purity and alloy specimens from the first controlled pressure-temperature capsule show the effectiveness of pressure in reducing swelling of U. A technique to thin dilute Fe-Si alloys of U for transmission electron microscopy yielded a method for determining the number of particles per unit volume in these alloys. The breadth of (111) and (112) x-ray-diffraction peaks in irradiated U was determined as a function of postirradiation annealing. Information concerning the mechanism of the $\beta \rightarrow \alpha$ transformation of Pu was derived from experiments on the effect of compressive stresses and transformation rates on this transformation. The effect of plastic deformation of (1) the parent beta and (2) parent gamma on the subsequent transformation to the phase stable at lower temperatures indicates that $\beta \rightarrow \alpha$ transformation is retarded and $\gamma \rightarrow \beta$ is accelerated. It is concluded that the increased strength of beta-phase Pu prepared by transformation from gamma as compared with transformation from alpha is related to crystallographic orientation differences. (J.R.D.)

30649 (HW-84573(p.4.1-31)) REACTOR METALS RESEARCH. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Nickel-base alloys are being tested to determine the effects of irradiation on their mechanical properties. Specimens of Hastelloy X-280 irradiated at 280°C to exposures 8.3×10^{20} nvt fast were tested at 650°C. Results from these tests show a marked reduction in ductility. Specimens of Inconel 625 were irradiated at 740, 280, and 50°C and tested at room temperatures. Data from these tests show that the higher irradiation temperature reduces the ductility of this material. Specimens of Inconel 625 irradiated to 1×10^{20} nvt fast were tested at room temperature, 300, and 650°C. The yield and ultimate strengths at the highest test temperature were about 50% of the room temperature values. Creep tests on annealed AISI 304 SS were started during the past quarter. Out-of-reactor tests produced creep rates of 7.8×10^{-4}/hr at 60 hr and 3.9×10^{-4}/hr at 380 hr. In-reactor elongation on breaking was about 8 to 9% after 145 hr, while out-of-reactor elongation was 29% after 480 hr. The prototype design of a high temperature in-reactor creep capsule was completed. The capsule will utilize Mo or W heaters to achieve operating temperatures of 1900°C. A high-temperature creep-rupture apparatus was developed. It can operate at temperatures of up to 1300°C. With the conclusion of ETR Cycles 66, 67, and 68, over 145 specimens were discharged from ETR core positions. The majority of these specimens were irradiated in the G-7 Hot Water Loop at approximately 550°F. Data from experiments on Zircaloy-2, stainless steels, nickel-base alloys, and refractory metal alloys are included. Tensile specimens fabricated from Zircaloy-2 tubing were used to determine weight gain and H_2 pickup as a function of time, temperature, and integrated neutron exposure. The corrosion rate of the irradiated material was found to be a factor of 10 greater than that of the same material exposed under identical conditions in out-of-reactor loops. A flux dependence was also observed when two specimens were irradiated for the same time at different flux rates. Studies are underway to determine the feasibility of using the double cantilever beam (DCB) specimen for evaluating the effects of in-reactor environments on the fracture properties of candidate reactor materials. Results were obtained using the DCB technique on A302-B and Zircaloy-2. The crack initiation fracture toughness values for A302-B show a strong temperature dependence between –165 and –120°C. The status of the theory of thermally activated flow which deals with the relationship between the effective stress and the activation energy is reviewed and compared with experimental results. (J.R.D.)

30650 (ORNL-3789(p.126-38)) MECHANISMS OF CORROSION OF ZIRCONIUM ALLOYS. G. H. Jenks (Oak Ridge National Lab., Tenn.).

The mechanism of radiation corrosion is being investigated by comparing the behavior of fast-neutron-irradiated specimens with unirradiated controls. Specimen pretreatments were varied to provide various amounts of oxide film and dissolved O_2 near the surface during irradiation. It was found that irradiation damage in the metal enhances corrosion, and a small retardation of corrosion results from irradiation of oxide film. It was also found that the damage in the metal is probably associated with dissolved O_2. The general equation $i = 2A \sinh BE$, which related the anodic film growth current i to the field across the oxide film E was shown to apply for anodic film growth on Zr in oxygenated dilute H_2SO_4 at 200 to 284°C. The temperature dependence of the field coefficient (B) was investigated. Results showed that B increases with temperature. The applicability of local field concepts which relate the dielectric behavior of the oxide through the dielectric constant ϵ was tested. Use of the Lorentz field, $[(\epsilon + 2)/3](V/X)$, led to more reasonable agreement with these than did use of the Maxwell field, V/X. It appears that a field-dependent movement of ions across the oxide film is an important step in the corrosion. (J.R.D.)

30651 (ORNL-3789(p.239-47)) MISCELLANEOUS STUDIES FOR SOLID-FUELED REACTORS. (Oak Ridge National Lab., Tenn.).

The cubic fluorite-structure solid solution of thoria and urania after equilibration in air at 1000 to 1550°C gives values for the mole fraction of UO_3 in the range from 0.3 to nearly 0.4 if the mole fraction of thoria is less than about 0.4. However, a correlation of lattice parameter with composition suggests that the mole fraction of UO_3 never exceeds 0.25. Studies of the UO_2–ZrO_2 system by equilibrating the oxide phases in the presence of molten fluoride mixtures at 500 to 1000°C were supplemented by high-temperature x-ray diffractometric observations of transformations in oxide mixtures of various overall compositions. In agreement with the results of previous studies in the presence of molten fluoride fluxes, the equilibrium oxide phases were found to consist only of the pure components (cubic UO_2 and monoclinic ZrO_2) at temperatures below 800°C. A tentative phase diagram for the UO_2–ZrO_2 system, involving a postulated intermediate phase of composition near $UO_2 \cdot 3ZrO_2$, is proposed for use in planning further work. A preliminary investigation was made of the stability of gaseous SO_2, a potential coolant for fast reactors, to irradiation at room temperature by alpha particles from radon. Initial mixing of the gases produced evidence of damage (marked Tyndall effect and separation of liquid phase), but examination after nearly complete decay of the radon suggested little damage. A compilation of the neutron flux spectra in the various experimental facilities (including the horizontal beam hole, poolside, and capsule irradiation facilities) was made. The compilation includes both the energy and the spatial variations of the neutron flux whenever data were available. (J.R.D.)

30652 (ORNL-TM-1146) PRODUCTION OF A LOW-BORON HEAT OF HASTELLOY N. W. R. Martin, H. E. McCoy, and J. R. Weir (Oak Ridge National Lab., Tenn.). June 11, 1965. Contract W-7405-eng-26. 3p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

In the melting of a vacuum-induction heat of Hastelloy N, it was determined that the raw materials are not the source of boron in the alloy. It was demonstrated that Hastelloy N can be produced in 50- to 75-lb ingots with a quantity of boron lower than normal. (D.L.C.)

30653 (TID-21723) DISPERSAL OF REACTOR CORE MATERIALS BY REENTRY PROCESSES. Quarterly Report. J. L. Beal, W. R. Brown, and F. A. Vassallo (Cornell Aeronautical Lab., Inc., Buffalo, N. Y.). Jan. 1965. For Sandia Corp., Albuquerque, N. Mex. Contract AT (29-1)-789, Subcontract No. 2. 48p. (CAL-114-020-1; SC-DC-1273). Dep.(mn); $2.00(cy), 2(mn) CFSTI.

Information about the rate of O_2 absorption by metallic Zr as it is heated from 500 to 3830°R is presented. This was accomplished by stopping the heating at various temperatures, cooling rapidly in an inert atmosphere, and determining the increase in weight due to O_2 absorption. The temperature rise of specimens was determined as a function of time and compared with that for otherwise identical specimens which were coated to prevent oxidation. Oxidation heating rates were computed from these data. Specimens were sectioned and examined microscopically. Test conditions were selected so that the diffusion-controlled rate of oxidation (the case in which all of the O_2 in the air which diffuses to the solid surface reacts) is comparable to that in free-flight conditions associated with reentry. The time of heating of the specimen from low to high temperature was an arbitrary variable. Specimens were heated from 500°R to high temperature in 3 to 15 seconds. The data resulting from this type of testing were scattered. (J.R.D.)

30654 (UCRL-7913) LEVITATION MELTING OF BERYLLIUM AND ALUMINUM. R. F. Bunshah and R. S. Juntz (Lawrence Radiation Lab., Univ. of California, Livermore). June 1964. Contract W-7405-eng-48. 13p. (CONF-603-11). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Transaction of Meeting, Vacuum Metallurgy, American Vacuum Society, New York, June-July 1964.

A method for levitation melting of 70–120 g charges of Al in air and 60–80 g charges of Be in a vacuum of 5×10^{-5} torr is described. Melts were cast into 1 and $1\frac{1}{2}$ in. dia rods without contamination. The limitations of the technique are discussed. (auth)

30655 (UCRL-13094) RESEARCH AND DEVELOPMENT ON ADHESIVES FOR URANIUM AND THORIUM. Annual Report, October 1, 1962–October 1, 1963. D. G. Glasgow and Ival O. Salyer (Monsanto Research Corp., Dayton, Ohio). Nov. 25, 1963. For Univ. of California Lawrence Radiation Lab., Livermore. Contract W-7405-eng-48, Subcontract 212. 41p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

An accelerated aging procedure was developed for U lap joints. Conditions of 140°F and 80% relative humidity destroy in 4 days or less U- to U joints bonded with commercial unfilled epoxy adhesives. Twelve organic materials were tested for compatibility with U and visual checking showed that an acid, anhydride, β-diketone, phosphate, and phosphine oxide were the most compatible. Reactive primers containing the epoxy function as one functional group and an acid, phosphate, phosphonate, anhydride or trimethoxysilyl as the primer function were obtained along with other trimethoxysilyl and silicone containing primers. The testing of the primers was done using an amine cured epoxy adhesive, i.e. Epon 828 and Versamid 115. Twelve primers containing eight different functional groups were used, the primers being applied by adsorption from solution. A study of the effect of the hydrophobic character of the adhesive was carried out using various vinyl polymers as the adhesive. The influence of the method of surface preparation on the ultimate bond strength and aging resistance was studied. An investigation into the possible usefulness of fillers as water getters was carried out. The fillers studied were Al, Al_2O_3, Mg, Zn, ZnO, B, PbO, and molecular sieves. These were incorporated into an epoxy adhesive. The effect of various levels of loading of a 7-μ-Al powder was also studied. The effect of reducing the number of edges available between U and an adhesive on aging resistance was determined using an Al-filled epoxy adhesive. A study to determine a method for applying monolayers of organic acids to U was initiated. (J.R.D.)

30656 (UCRL-Trans-1199(L)) DEVELOPMENT IN THE FIELD OF OXIDE-BASED CERAMICS. H. J. Oel. Translated by D. McCallum (Univ. of California Lawrence Radiation Lab., Livermore), from Bull. Soc. Franc. Ceram., 63: 15-25(Apr.-June 1964). 29p. Dep.(mn); $2.60(fs), $1.07(mf) JCL.

An examination is made of certain aspects of refractory oxide ceramics which may be representative of future developments. Various trends in the development of these materials are discussed: increasing purity, particle size measurement in powders by x-ray method, and applications. The effects of sintering on the properties of ThO_2, CaO, and MgO are discussed, and the influence of additives on sintering are considered. The suppression of undesirable properties, such as fragility, is considered briefly. (D.L.C.)

30657 ZIRCONIUM DIBORIDE FROM ZIRCON. J. C. McMullen and W. Dean McKee, Jr. (Carborundum Co., Niagara Falls, N. Y.). Am. Ceram. Soc. Bull., 44: 488-91 (June 7, 1965).

Zircon, boric oxide, and carbon were reacted in a submerged electrode arc furnace, yielding a reasonably pure zirconium diboride in a one-step process. The experimental procedure and results are described. (P.C.H.)

30658 VAPO-METALLURGY. ARTICLE III. PREPARATION OF REFRACTORY METAL POWDERS WITH UNUSUAL PROPERTIES. S. H. Smiley, D. C. Brater, and H. L. Kaufman (Oak Ridge Gaseous Diffusion Plant, Tenn.). J. Metals, 17: 605-10(June 1965).

The production of Mo, W, and Mo–W alloy powders possessing fine particle sizes with very large surface areas and small impurity contents is described. The process uses the H_2–F_2 flame reduction of the metal hexafluoride. (W.L.G.)

30659 REMOTE METALLOGRAPHIC MICROSCOPY. F. L. Cochran. Nucl. News, 8: No. 6, 13-18(June 1965).

Historical and modern aspects of metallographic microscopy are reviewed. Emphasis is given to specimen preparation, particularly the remote preparation of irradiated materials, and factors influencing the different preparation techniques are discussed. (W.L.G.)

30660 THE REMOVAL OF MOLYBDENUM FROM TUNGSTIC ANHYDRIDE. E. P. Bogomil'skaya and R. M. Sviridovskaya. p.117-26 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

A technique is described for the production of tungstic anhydride that contains less than 0.1% Mo. It is accomplished by the decomposition of calcium tungstate by HCl in the presence of powdered tungsten. The method is used in the production of tungstic acid with less than 0.02% Mo, for the electric lamp industry. (Rev. Metal Lit., 22: No. 5, May 1965)

30661 PROCESS FOR THE MANUFACTURE OF VERY PURE BORON. (to Wacher-Chemie GmbH). British Patent 982,893. Feb. 10, 1965. Priority date Apr. 28, 1960, Germany.

A process for the manufacture of high purity boron consists of heating a boron body that contains intentional impurities in an atmosphere that promotes the thermal splitting of a boron compound in the atmosphere. The body may be in various forms and is pre-heated until the temperature and conductivity are sufficient to allow further heating to the reaction temperature by means of a direct current. The boron compound for thermal splitting may be either boron hydride or a partially halogenated boron hydride. The boron compound is brought into contact with the boron body either with or without a reactive or non-reactive gas at a temperature above the splitting temperature of the boron compound. The boron compound to be split is conducted through one or more nozzles that may be moving and/or additionally cooled directly to the heated body. (B.L.M.)

30662 IMPROVEMENTS IN AND RELATING TO MAGNESIUM–ZIRCONIUM ALLOYS. Peter Greenfield (to English Electric Co. Ltd.). British Patent 983,361. Feb. 17, 1965. Filed July 27, 1960.

A direct alloying process is described for the production of a Mg–Zr alloy containing 0.15–0.8% Zr that is particularly suitable for use as a fuel element canning material in gas cooled reactors. The alloy is useful at operating temperature up to 400°C above which a slow embrittling process begins. The Zr content of the alloy

may also be present as the hydride. The Mg–Zr alloy can be subjected to a hydrogenizing process at temperatures of 350–650°C in a hydrogen atmosphere to convert the Zr to ZrH_4, or the ZrH_4 powder can be added directly to the molten Mg followed by suitable stirring and casting. (B.L.M.)

30663 IMPROVEMENTS IN OR RELATING TO URANIUM ALLOYS. David John Marsh (to United Kingdom Atomic Energy Authority). British Patent 983,803. Feb. 17, 1965. Filed Feb. 11, 1963.

A U–Mo–Nb alloy is produced by placing an Mg-reduced U billet in a graphite crucible with the Mo and Nb added in the form of a 3% or 6% master alloy with U or in the form of the pure metal and melting by high-frequency induction heating in a vacuum. The melt is held at 1500–1550°C for five minutes and then poured into an alumina-sprayed graphite mold while still in a vacuum. The alloy contains 0.8-1.2 at. % Mo and 0.8-1.2 at. % Nb and has an average grain size of 175–225 μ. The cast alloy can be further grain refined by heating to a temperature in the range of 700–900°C and continuously cooling from this temperature at a rate of 100 to 250°C per minute. After the heat treatment, the alloy has a grain size of 50–100 μ. (B.L.M.)

30664 METHOD FOR THE PRODUCTION OF METAL BORIDES. Frederick Tepper, John W. Mausteller, Santa Kumar Kabi, and Ludwig Luft (to Mine Safety Appliances Co.). German Patent 1,189,055. Mar. 18, 1965. Priority date Apr. 21, 1960, United States.

A method for the production of borides is given that comprises the steps of reacting the metallic components of the groups IIIB, IVB, VB of the periodic system, of the rare-earth elements, the actinides, magnesium, calcium, strontium, barium, manganese, iron, nickel, chromium, and tungsten, with a boron component, which consists of elementary boron or the oxides, halides, borates, or the mixtures of all these, in an inert gaseous atmosphere at temperatures of at least 815°C, in a melt of sodium and/or potassium, and of separating the borides from the metallic melt. (Gmelin Inst.)

Corrosion

Refer also to abstracts 30150 and 30394.

30665 (AWRE-O-18/65) THE CORROSION AND IGNITION BEHAVIOUR OF SOME URANIUM–PLUTONIUM–IRON ALLOYS. PART 2. ALLOYS CONTAINING MORE THAN 8 a/o IRON. G. Picton and J. F. Sackman (Atomic Weapons Research Establishment, Aldermaston (England)). May 1965. 15p. Dep.(mn); $0.80(BIS); 3s. 3d. (HMSO).

Alloys containing 16.2 and 16.8 at.% Fe were compared with an alloy containing 7.7 at.% Fe. There was no improvement in either the corrosion or the ignition behavior. Under accelerated corrosion conditions the 16.2 at.% Fe alloy can corrode more rapidly at ~0% relative humidity than at 95% relative humidity because of cracking and disintegration. It is concluded that casting conditions are the most important parameters for good corrosion and ignition behavior. (auth)

30666 (BNWL-29) STATIC TESTS OF CORROSION INHIBITORS FOR ALUMINUM AND CARBON STEEL. R. B. Richman (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1965. Contract AT(45-1)-1830. 30p. Dep.; $2.00(cy), 1(mn) CFSTI.

Uniform corrosion losses and pitting tendencies were measured for carbon steel and aluminum samples exposed for as long as 9½ months at ambient temperature in static, nonrefreshed solutions of 38 different inhibitor mixtures. Results from these tests indicate that two inhibitors: (1) sodium hexameta-phosphate, and (2) sodium nitrite plus sodium silicate, are possible candidates to replace sodium dichromate in dynamic or static systems that contain both carbon steel and aluminum. Three additional inhibitors reduced the uniform corrosion of carbon steel. Limited measurements of inhibitor depletion were obtained, but the effects of this depletion on corrosion were not defined. (auth)

30667 (COO-1319-24) A STUDY OF THE MECHANISM OF STRESS CORROSION CRACKING IN THE IRON-NICKEL–CHROMIUM ALLOY SYSTEM. Quarterly Report, December 17, 1964–March 16, 1965. R. W. Staehle, F. H. Beck, M. G. Fontana, and J. P. Hirth (Ohio State Univ. Research Foundation, Columbus). Apr. 5, 1965. Contract AT(11-1)-1319. 29p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Results of measurements of the stress-corrosion cracking in a 600°F, 0.1 wt % NaCl, 100 psi O_2 over-pressure environment, and the tensile properties at room temperature of a series of Cr–Fe–Ni alloys are reported. (W.L.G.)

30668 (EURAEC-1274) FURTHER DEVELOPMENT OF THE ZIRCONIUM ALLOY ZrNb3Sn1 WITH A VIEW TO ITS USE AS CLADDING MATERIAL IN WATER-COOLED NUCLEAR REACTORS. Quarterly Report No. 4, July 1–September 30, 1964. (Metallgesellschaft A. G., Frankfurt am Main (West Germany)). Dec. 10, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 019-63-11 TEED. 14p. (EUR-2075). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Comparative corrosion tests on ten Zr–3Nb–1Sn alloys containing Fe, Cr, Cu, U, and Sb additions exposed to steam at 400 and 450°C were performed. The results obtained after 1,970 hr show that Sn has in all cases an adverse effect on the weight increase. The elongation is reduced by the corrosion attack after only 500-700 hr. In short-term hot tensile tests carried out at 450°C, a reduction in the Nb content led in all cases to lower strength than in the case of Zr–3Nb–1Sn. Creep tests on the same alloys at 450°C showed, however, that both the alloys containing Sb, V and Cr and those containing Fe and Sn were superior to the reference alloy. A higher creep elongation was observed particularly in the Sn-free alloys containing Fe and Cu. (W.L.G.)

30669 (HW-84573(p.5.1-22)) CHEMICAL METALLURGY. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Analyses of zirconium alloy specimens discharged from the ETR G-7 loop following 16.5 days' exposure to the low-O_2 280°C water were continued and comparisons were made with control coupons exposed to deoxygenated water in an out-of-reactor autoclave. Results indicate that the weight gains of all alloys tested are comparable at each flux position and there is no effect of extent of cold work or of cold work versus annealing on weight gains. H_2 pickup fractions were generally higher for all irradiated specimens. Zircaloy-4 and Ni-free Zircaloy-2 alloys showed marked increases in pickup fractions with increasing flux intensity. Hastelloy X-280 and Haynes 25 were thermally cycled in 25-torr O_2 at room temperature to 2048°F. After 9 cycles (450 hr at 2048°F) Hastelloy X-280 was found more resistant to oxidation, under conditions of thermal cycling than Haynes 25. Samples of Haynes 25 and Hastelloy X were exposed to He at 350 psi and 2050°F, at velocities of the order of 525 fps. Oxidation rates of these alloys in the He flow compare favorably with oxidation rates in a static system at equivalent O_2 pressures. A revised Zr electrolytic O_2 probe was designed which uses air as a reference O_2 partial pressure. The new probe follows the theoretical voltage from below 1 ppM to 21% O_2. Zircaloy corrosion coupons attached to a PRTR fuel element were irradiated for 2000 hr; the irradiation is continuing. Al alloys containing 7 to 10% Si plus Ni and/or Mg are being compared with 8001 Al for corrosion in 140, and 50°C process water and in high-purity, high-temperature water. Ni-containing Si alloys are more resistant to 400°C steam than 8001. All the Si alloy specimens pitted when galvanically coupled to stainless steel. No evidence of stress corrosion on any of the alloys was found. Three Ni-plated Pu-Al fuel elements and five plated 8001 Al dummy elements were exposed in the C-1 in-reactor loop for approximately 1 month in pH 5.5 to 7.3 water at 260°C. The Ni plate was chemically deposited in thicknesses of 0.4 and 0.8 mils; the plated elements were subjected to heat treatments of 2.5, 10, and 40 hr at 400°C. Postirradiation metallography shows that the plate was retained, with relatively little corrosion on dummy elements (0.8 mil plate); attack on fueled elements

was more pronounced, but was contained by Ni/Al diffusion layers. (J.R.D.)

30670 (NASA-CR-54332) CAVITATION DAMAGE IN LIQUID METALS. Technical Progress Report, April 20–December 31, 1963. C. E. Couchman, III, H. S. Preiser, and A. Thiruvengadam (Hydronautics, Inc., Laurel, Md.). Mar. 10, 1965. Contract NAS-3-4172. 54p. (TPR-467-1)

The operational experience in installing and calibrating a controlled environment test chamber is discussed. This experimental facility has been designed specifically for conducting investigations on the cavitation damage resistance of refractory alloys in pure liquid sodium at temperatures up to 1500°F. An absolute vacuum as low as 2.5×10^{-9} torr and a leak rate as low as 10×10^{-3} torr per hour have been achieved. This facility is capable of maintaining oxygen and moisture levels so as to maintain the test purities less than 50 ppm of oxygen over an eight hour period. Preliminary experiments with 316 stainless steel in 1000°F sodium showed that the intensity of damage at this temperature is very much lower than that at 400°F. A modified design of the high frequency fatigue specimens was made and some preliminary experiments were conducted. A preliminary design for stress corrosion tests was made. Available data on the mechanical properties of the test metals at high temperatures will be analyzed for correlation with cavitation damage resistance. (auth)

30671 (ORNL-3789(p.122-5)) CORROSION STUDIES FOR AQUEOUS REACTORS AND CHEMICAL PROCESSES. J. C. Griess, J. L. English, L. L. Fairchild, and P. D. Neumann (Oak Ridge National Lab., Tenn.).

Corrosion testing in support of the High Flux Isotope Reactor was completed. Dynamic and static tests were conducted on Al alloys and Be in water adjusted to a pH of 5.0 at 50 and 100°C. The corrosion of neither metal was sufficient to preclude its use in the construction of the reactor. Tests with other materials, including plastics, were conducted to determine their suitability in reactor components. Corrosion tests in various chloride-containing solutions of direct interest to the Transuranium Processing Facility were completed; most tests were of the behavior of Ta and Zr. Both materials have adequate corrosion resistance to the process solutions, but both absorb corrosion-product H which, in sufficient quantities, produces embrittlement. The corrosion resistance of metals and alloys was examined in gaseous and aqueous environments of interest to various fuel element reprocessing schemes. In addition, the corrosion resistance of type 304 ELC stainless steel was determined in calcining waste products with and without additions of glass-forming chemicals. (auth)

30672 (ORNL-3789(p.202-7)) REACTIONS OF GRAPHITE WITH OXIDIZING GASES. L. G. Overholser (Oak Ridge National Lab., Tenn.).

The rates of reaction of a 1-in.-dia. sphere of ATJ graphite (the graphite used as the outer shell of AVR fuel spheres) with low concentrations of H_2O and CO_2 in flowing He (1 atm) were measured at 775 to 975°C. Activation energies of ~50 and ~60 kcal/mole were found for H_2O and CO_2, respectively, at oxidant concentrations in the range of 100 to 500 vpM (parts per million by volume). Apparent orders of ~0.6 were observed for both the H_2O- and CO_2-graphite systems at 875°C and oxidant concentrations ranging from 50 to 750 vpM. Reaction rates increased with increasing burnoff and increasing flow rates. The H_2O- and CO_2-graphite reactions were found to be strongly retarded by both H_2 and CO additions. Oxidation of 1.5-in.-dia. unfueled spheres of ATJ and Speer Mod-2 graphites by steam (partial pressure of ~730 torrs) was studied at 800, 900, and 1000°C. Similar studies of 2.36-in.-dia. ATJ graphite spheres, simulated AVR spheres, and fueled mold-injected AVR spheres also were performed. A linear relationship was found between the reaction rates and surface area of the remaining specimen over a wide range of burnoffs for both grades of graphites at 1000°C. Activation energies of ~50 and ~60 kcal/mole were measured for 2.36- and 1.5-in.-dia. ATJ spheres respectively. Smaller CO to CO_2 ratios were found in the effluent gases obtained from the larger spheres. Simulated and fueled AVR spheres gave reaction rates and activation energies approximating those found for the 2.36-in.-dia. ATJ spheres. (J.R.D.)

30673 (ORNL-3789(p.293-305)) CHEMICAL SUPPORT FOR SALINE WATER PROGRAM. (Oak Ridge National Lab., Tenn.).

Solubilities of $CaSO_4$ in aqueous $NaNO_3$ solutions were determined at 125 to 350°C. On the basis of newly and previously determined values for the solubilities of $CaSO_4$ in $NaCl-H_2O$ and $NaNO_3-H_2O$ solutions to 350°C, a general computer program was written that permitted the iterative calculation of concentration limits in saline waters at temperatures between 25 and 350°C within which precipitation either of $CaSO_4$, $CaSO_4 \cdot \frac{1}{2}H_2O$, or $CaSO_4 \cdot 2H_2O$ is avoided. A Ti loop was equipped for carrying out electrochemical corrosion studies in flowing solutions. Exploratory experiments indicate that polarization behavior and corrosion rates can be studied to temperatures of 200°C. Attack of Ti alloys in NaCl solutions at elevated (≥100°C) temperatures was observed. This attack was initially observed in connection with studies of the corrosion of Al alloys in such solutions, being carried out in Ti equipment. Ti specimen holders used in exposing the Al alloys were clamped together with bands made of 0.008-in. A55 Ti sheet stock. Observations indicate that the severity and frequency of attack increase with temperature above 100°C. Attack increases with acidity but has been observed at pH values up to 8.7. The frequency of attack increases with exposure time. Attack occurs with a variety of alloys, although preliminary results indicate that a 0.2% Pd alloy is more resistant. Results of polarization studies with Ti electrodes indicate appreciable overvoltage for the reduction of O_2 in 1M NaCl solutions. In the absence of O_2, Ti polarizes severely, with cathodic current densities being very low until a cathodic potential sufficient for the reduction of water is achieved. Anodic polarization experiments show no active region in 1M NaCl at pH values of either 3 or 6, with or without O_2, at 100 to 200°C. (J.R.D.)

30674 (ORNL-3790) TYPE 316 STAINLESS STEEL, INCONEL, AND HAYNES ALLOY NO. 25 NATURAL-CIRCULATION BOILING-POTASSIUM CORROSION TEST LOOPS. D. H. Hansen and E. F. Hoffman (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 101p. Dep.; $4.00(cy), 3(mn) CFSTI.

An investigation was andertaken to determine the compatibility of conventional nickel-, iron-, and cobalt-base high-temperature alloys with boiling potassium. The tests were designed to obtain quantitative information on the dissolution of the container alloys by condensing potassium and the subsequent deposition of solute in a subcooled liquid region of the test device. Studies were conducted in natural-circulation loops, two of which were fabricated from type 316 stainless steel, two from Haynes alloy No. 25, and one from Inconel. Each of the alloys was operated at a maximum boiler-condenser temperature of 870°C for 1500 to 3000 hr, and the Haynes alloy No. 25 was also tested for 3000 hr at 980°C. The potassium condensing rates at the two temperatures were 170 to 180 and 300 g/min, respectively. At 870°C type 316 stainless steel and Haynes alloy No. 25 exhibited comparable resistance to attack by boiling potassium, while Inconel showed greater deterioration. Carbon was transferred from the condensing region to the subcooled liquid region in all the loop tests. Attendant with this, the elongation of the material decreased and the tensile strength increased. No evidence of preferential leaching of major metallic constituents of these alloys was detected by electron microprobe analysis of the condenser surfaces. However, limited mass transfer from the hot region to the cold region was noted. (auth)

30675 (SRIA-132) HIGH-TEMPERATURE OXIDATION AND NITRIDATION OF NIOBIUM IN ULTRAHIGH VACUUM. Final Report, July 1, 1963–October 31, 1964. R. A. Pasternak (Stanford Research Inst., Menlo Park,

Calif.). Nov. 15, 1964. Contract AT(04-3)-115. 63p. Dep.; $3.00 CFSTI.

An intensive ultrahigh vacuum study of the interactions of N_2, O_2, and N_2–O_2 mixtures with clean Nb was performed. The kinetics of sorption and degassing of N_2 were investigated and the thermodynamic equilibrium for solution of N_2 in Nb determined. Detailed mechanisms for these processes were formulated that explain reasonably well the experimental data. The kinetics of the sorption of O_2 were determined and the dissociation of O_2 molecules on the hot metal surface and evaporation of a volatile NbO from the hot sample were measured. The reaction of N_2–O_2 mixtures at low pressures with Nb could not be explained on the basis of independent sorption of the individual gases with Nb. It appears that a catalytic reaction leading to the formation of nitrogen oxides occurs and stable surface layers containing both N_2 and O_2 are formed. (W.L.G.)

30676 (ORNL-tr-515) CORROSION OF CONCRETE REINFORCEMENT IN SEA WATER. Zhavoronkina, V. K. Translated for Oak Ridge National Lab., Tenn., from Tr. Mosk. Gidrofiz. Inst., Akad. Nauk SSSR, 10: 106-18(1957). 21p. Dep.(mn); $1.00(cy), 1(mn) CFSTI; $2.60(fs), $0.83 (mf) JCL.

Results are presented of experimental studies on the conditions for the generation and development of corrosion of reinforcements. The rate of corrosion of reinforcements in sea water was studied, and the thickness of a protective concrete layer which ensures the preservation of reinforcements in reinforced concrete was established. Electrochemical studies, used for the first time in the corrosion of reinforcements (a study of the operation of a model of local elements, obtaining polarization curves), made it possible to determine the basic laws of electrochemical corrosion processes occurring on the surface of reinforcements beneath a concrete layer. (auth)

30677 BEHAVIOR OF PURIFIED NUCLEAR GRAPHITE IN THE COURSE OF A SUCCESSION OF TREATMENTS IN OXYGEN AT 620°C AND DEGASIFICATION UNDER VACUUM. F. M. Lang, C. Koch, and A. Merle (Commissariat a l'Energie Atomique, Saclay, France). Carbon, 2: 15-21 (Aug. 1964). (In French)

The sample was oxidized in oxygen at 620°C, then degassed under vacuum in the same apparatus, in successive steps from 250 to 1700°C. If the oxidation rate measurement was preceded by a degassing above 1000°C, an initial transitory period was observed during which this rate was at first considerably lower than normal, after which it increased rapidly and, when dry oxygen was used, passed through a high maximum. After a certain time the oxidation rate regained the value it would have attained without degassing. As with oxidation in air, oxidation in oxygen to a 10% weight loss did not eliminate the gases fixed on the graphite before oxidation. On the other hand, by degassing under vacuum up to 1700°C after oxidation the greater part of these gases could be eliminated, giving a sample suitable for the study of the effect of humidity on oxidation. The presence of water in the oxygen led to an excess quantity of CO and H_2 during desorption. The carbon monoxide was mainly given off below 1000°C and the hydrogen between 1000 and 1300°C. The total composition of this gas was generally higher in CO than in H_2, by comparison with that of water gas. Even if the concentration of water present during oxidation was varied within wide limits, the excess quantity of gases desorbed was found to be of the same order. This effect must be related to the inhibiting action of water on the oxidation rate of graphite. (auth)

30678 ON THE KINETICS OF OXIDATION OF GRAPHITE. J. N. Ong, Jr. (Lockheed Missiles and Space Co., Palo Alto, Calif.). Carbon, 2: 281-97(Dec. 1964).

The kinetics of the graphite–oxygen system were examined with respect to two primary reactions, $C + O_2(g) \rightarrow CO_2(g)$ and $2C + O_2(g) \rightarrow 2CO(g)$, and one secondary reaction, $C + CO_2(g) \rightarrow 2CO(g)$. Adsorbed molecular oxygen ($C..O_2$), atomic oxygen (C..O) and carbon dioxide ($C..CO_2$) were assumed as intermediate species from which seven thermochemically and kinetically consistent processes were proposed. Categorization of the proposed kinetic scheme was made with respect to simultaneous or consecutive formation of products, successive and competitive processes, open and closed systems, high and low temperatures, reversible and irreversible behavior, reversible behavior of the first and second kinds, mechanism, and molecularity. Under the restriction of stationary-state conditions and other limiting conditions, both high- and low-temperature and high- and low-pressure experimental results are rationalized with respect to temperature and pressure dependencies on rates, orders of reaction, and the sensitivity of the rates to the flow of gases. (auth)

30679 THE EFFECT OF DIFFUSION AND BULK GAS FLOW ON THE THERMAL OXIDATION OF NUCLEAR GRAPHITE. I. TEMPERATURES BELOW 500°C. P. Hawtin, J. A. Gibson, R. Murdoch, and J. B. Lewis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Carbon, 2: 299-309(Dec. 1964).

The role played by in-pore gas transport in limiting the rate of oxidation of nuclear grade graphite in air was investigated at temperatures of 435, 460, and 485°C. A mathematical model was developed, which accurately predicted the effect of simultaneous diffusion and bulk gas flow on the thermal oxidation kinetics. (auth)

30680 THE ORDER OF REACTION FOR THE OXIDATION OF NUCLEAR GRAPHITE IN DRY OXYGEN-NITROGEN MIXTURES. J. B. Lewis, P. Connor, and R. Murdoch (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Carbon, 2: 311-14(Dec. 1964).

The order of reaction for the oxidation of British pile grade A graphite in dry oxygen–nitrogen mixtures containing between 2.5 and 20% oxygen and at a total pressure of 1 atm was determined at temperatures of 575, 595, and 655°C. Values of between 0.54 and 0.60 were obtained. The presence of CO_2 in the oxidizing gas had no effect. Except possibly at the lowest value the ratio of CO/CO_2 in the product was independent of oxygen concentration. (auth)

30681 CORROSION MECHANISM OF ZIRCONIUM AND ITS ALLOYS. III. SOLUTE DISTRIBUTION BETWEEN CORROSION FILMS AND ZIRCONIUM ALLOY SUBSTRATES. D. L. Douglass (S.C.K.–C.E.N., Mol, Belg.). Corrosion Sci., 5: 347-60 (May 1965).

Analyses of stripped corrosion films were performed by wet chemical methods, neutron activation and by electron microprobe analysis. It was found that the amount of tin, niobium, and chromium in post-transition oxide films was directly proportional to the amount in the alloy. There was no measureable difference in film composition of a given alloy as a function of film thickness, and the combination of alloying elements in ternary alloys had no effect on the amount of a given element in the corrosion film. Analyses of a pre-transition film in a Zr–1 Cr binary alloy were made by using a tracer, ^{51}Cr. No concentration differences in chromium were found in corrosion films formed in 400°C steam over a range of thickness from 7000 to 18,000 Å. It was concluded that this alloy did not exhibit concentration changes in the substrate adjacent to the oxide film as found by Wagner for Ni–Pt alloys, and that diffusion of chromium in the metal was unimportant for this particular case. The beneficial effect of chromium and harmful effect of both tin and niobium on post-transition corrosion rates can be associated with the amount of solute in the film, although no suitable mechanism for these effects can be found at present. (auth)

30682 INFLUENCE OF THE STRUCTURE OF ZIRCALOY-2 ON ITS CORROSION RESISTANCE BY WATER VAPOUR. H. Demars, J.-P. Givord, and M. Armand (S.E.C.E.M. et A.E.U. Laboratoire de Recherches, Venthon, France). Mem. Sci. Rev. Met., 62: 269-74(Apr. 1965). (In French)

The α-β transformation cycle and the influences of structural homogenization, cooling rate from the β-phase, work hardening, and recrystallization annealing on the structure of Zircaloy-2 were studied. The effects of these treatments on the corrosion in water vapor at 400°C and 105 kg/cm^2 pressure for 14 days are reported. (W.L.G.)

30683 THE INTERMEDIATE-TEMPERATURE OXIDATION BEHAVIOR OF MOLYBDENUM DISILICIDE. Joan B. Berkowitz-Mattuck (A. D. Little, Inc., Cambridge, Mass.), Paul E. Blackburn, and Edward J. Felten. Trans. Met. Soc. AIME, 233: 1093-9(June 1965).

The oxidation behavior of $MoSi_2$ was studied between 450 and 650°C, the temperature region where "pesting" occurs. Disintegration ("pesting") of $MoSi_2$ is shown to occur in the presence of oxygen, but not nitrogen, carbon dioxide, carbon monoxide, or argon. The rate of disintegration is extremely sensitive to oxygen pressure. The crack density of polycrystalline $MoSi_2$ increases with time at temperature. All kinds of cracks were observed; those which are confined within a single grain, those that cross grain boundaries transversely, and those that follow grain boundaries. Lane photographs verify the existence of transcrystalline cleavage. Single crystals of $MoSi_2$ do not "pest." The solubility of oxygen in $MoSi_2$ is extremely low, no lattice changes were observed as a result of exposure of $MoSi_2$ to oxygen in the "pest" temperature range. (auth)

30684 THE OXIDATION OF LITHIUM-CONTAINING NICKEL. W. C. Hagel (General Electric Research Lab., Schenectady, N. Y.). Trans. Met. Soc. AIME, 233: 1184-6(June 1965).

Lithium was alloyed with nickel to determine whether it was a more effective oxidation inhibitor than the external vapor. Lithium was added in amounts up to 1 wt % and the oxidation studied at 600 to 1300°C in pure, dry oxygen at 100 mm Hg. The optimum amount of lithium appeared to be 0.65 wt %; this amount reduced the oxidation rate by a factor of 5 at 1100°C. The alloying of lithium with nickel reduced the oxidation rate to a greater extent than the previous use of Li_2O vapor. (W.L.G.)

30685 PKP-2 PUMP AND TEST LOOP (Engineering Materials). (Oak Ridge National Lab., Tenn.). 48 drawings. (CAPE-1074)

The PKP-2, sump-type, centrifugal pump is used in metallurgical heat transfer, and reactor experiments to circulate liquid metals and molten salts in corrosion loops at temperatures to 1500°F. It has a capacity of 400 to 1500 gpm. (For Details, See TID-4100) (P.C.H.)

Fabrication

Refer also to abstracts 31486, 31520, and 31586.

30686 (AD-608945) HIGH-ENERGY-RATE EXTRUSION. Final Report. J. M. Rippel (Westinghouse Electric Corp., Blairsville, Pa.). Oct. 1, 1964. Contract AF33(600)-41948. 202p. (ML-TDR-64-312). $6.00 (CFSTI).

Thin structural shapes were produced by high velocity extrusion equipment. Tooling, dies, die coatings, lubricants and general processing parameters were developed to produce Ti alloy, stainless steel, low alloy steel and refractory metal alloy shapes. Extruded Tee sections, 2 in. by 1 in. by 0.050 in. thick, were made in lengths of 10 ft from Ti–6Al–4V, AISI 4340, and 304 stainless steel. These extrusions had uniform surfaces (100 rms or better) and good dimensional tolerances (±0.005 inch). The refractory metal alloys of Mo and Nb were made in shorter lengths and generally did not have as good a surface finish or tolerance. Dies coated with 0.010 inches of zirconia and lubricated with graphite proved much superior to conventional tool steel dies resisting wear at extrusion temperatures up to 3200°F. The die entry angle of 90° was important in reducing the initial peak stresses to a controllable level and tooling failures were reduced by using high strength (Rc 55-60) steels, which withstood pressures of 300,000 psi. The tendency for inertial separation (the phenomenon wherein the extrusion pulls itself apart because of the high inertial forces present) can be lessened and eliminated in many cases by the selection of low reduction ratios (15 : 1 or below) and low impact speeds. (auth)

30687 (ANL-6928) CONSOLIDATION AND FABRICATION TECHNIQUES FOR VANADIUM-20 w/o TITANIUM (TV-20). W. R. Burt, Jr., W. C. Kramer, R. D. McGowan, F. J. Karasek, and R. M. Mayfield (Argonne National Lab., Ill.). Feb. 1965. Contract W-31-109-eng-38. 83p. Dep.; $3.00(cy), 2(mn) CFSTI.

Methods are presented covering a recently developed technology for the consolidation and fabrication of bar, rod, sheet, and high-quality, small-diameter (<5-mm), thin-wall (<0.5-mm) tubing of a V–20 wt % Ti (TV-20) alloy. Consolidation included electron-beam (EB) melting of compacted vanadium chip and titanium sponge drip rods, followed by arc-melting of the EB ingot. The arc-cast ingots were broken down by extrusion. Sheet-bar and tube blanks were produced by a re-extrusion process. Cold rolling of bar, rod, and sheet products was accomplished with little difficulty. Tube blanks were cold-finished by swaging and drawing. The alloy showed a pronounced tendency to gall during drawing through carbide dies. This and other processing problems were overcome, and high-quality tubing was produced in the desired quantities. Additional evaluation of the alloy included annealing and other heat-treatment studies and pertinent, room-temperature, mechanical-property tests. Industrial participation in the program has been encouraged, and early results are reported. (auth)

30688 (CEA-R-2750) LE FILAGE DES METAUX SOUS PRESSION HYDROSTATIQUE. (Metal Extrusion Using Hydrostatic Pressures). Charles Sauve (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires). Feb. 1965. 76p. Dep.(mn)

The main problems connected with the deformation of metals due to extrusion are described. A method is proposed for calculating the rational rate of percentage deformation in the case of bar extrusion using a cylindrical container; reference is made to previous work on extrusion using a hydrostatic pressure with or without back-pressure. An extrusion process is described using hydrostatic pressure, without back-pressure, and using the lubricant for transmitting the thrust. This process leads to excellent surface textures. A very fine crystallization can be obtained on extruded products when the rate of extrusion is very low. High extrusion rates can also be used. (auth)

30689 (HW-51911) ULTRASONIC WELDING OF RIBS FOR PROJECTION FUEL ELEMENTS. J. T. Mommsen (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Apr. 28, 1958. Contract AT(45-1)-1350. 19p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A description is given of the development of an ultrasonic welding process for welding solid aluminum ribs to aluminum-clad fuel elements. A satisfactory technique was developed, but the project was discontinued due to the considerable damage caused to the process tube during a rupture or during discharge after rupture. (W.L.G.)

30690 (ML-TDR-64-270) TANTALUM AND MOLYBDENUM BRAZING TECHNIQUES. A. H. Freedman, L. H. Stone, and E. B. Mikus (Norair Div., Northrop Corp., Hawthorne, Calif.). Sept. 1964. Contract AF33(657)-11227. 198p. (AD-606576). $5.00(CFSTI).

The purpose of this program was to develop Mo and Ta braze systems, which braze at relatively low temperatures, but develop high remelt and service temperatures. Some attention was also directed to the development of braze alloys for Ta that braze several hundred degrees above the expected service temperature. Most of the effort was based on TZM Mo alloy and Ta–10W alloy. Some work was performed using a Ta–8W–2Hf and Ta–30Nb–7.5V. The most promising method of developing high remelt temperatures involved the diffusion sink brazing approach. A Ti–25Cr–13Ni diffusion sink braze alloy, which melted at 2200°F, produced the highest remelt temperatures on TZM. Remelt temperatures of tee joints exceeded 3100°F under a 120 psi stress. Lap joint remelt temperatures exceeded 3200°F and shear strength exceeded 250 psi at 3000°F. Remelt temperatures as high as 3180°F were attained on honeycomb specimens. In all cases, acceptable room temperature ductility was maintained. Pure Ti, Ti–30V, and 33Zr–34Ti–33V diffusion sink braze alloys produced the highest remelt temperatures on Ta–10W. Remelt temperatures of lap and honey-

comb specimens exceeding 3800°F were achieved with Ti and Ti–30V following a diffusion treatment of 2850°F for 24 hours. Lap shear strengths at 3500°F were 3800 to 4270 psi and 2160 to 3050 psi with Ti and Ti–30V, respectively. The lower melting (2480°F) 33Zr–34Ti–33V braze alloy produced good remelt increases and high strengths for service to approximately 3000°F. A Nb–1.3B conventional braze alloy (braze temperature 4200°F) for either vacuum or Ar brazing of Ta–10W exhibited lap shear strengths of approximately 4000 psi at 3500°F. Pure Ti, Ti–30V, and 33Zr–34Ti–33V diffusion sink braze alloys as well as the conventional alloy Nb–1.3B were evaluated on the Ta–8W–2Hf and Ta–30Nb–7.5V alloys. In general, tee and lap joint strengths were equivalent to those achieved on Ta–10W. Room temperature ductility of all tantalum alloys and brazed lap joints was adequate based on transition temperature tests. (auth)

30691 (N64-28460) CASTING OF BERYLLIUM–STAINLESS STEEL AND BERYLLIUM–COLUMBIUM IMPACT TARGET COMPOSITES. Summary Report. C. J. Patenaude and W. H. Santschi (Beryllium Corp., Reading, Pa.). June 9, 1964. Contract NAS-3-3729. 38p. (NASA-CR-54144). $3.60(CFSTI).

Tubular composites of cast beryllium–stainless steel (SS) and cast beryllium–niobium were produced to serve as impact targets in tests of beryllium's resistance to simulated meteoroid collisions. Four basic approaches were undertaken to produce these composites, all aimed at achieving a metallurgical bond at the Be–SS and Be–Nb interfaces: (1) direct casting of the Be around SS and Nb tubing; (2) coextrusion of cast Be and SS; (3) Ag brazing of cast Be to SS; and (4) solid state diffusion bonding of cast Be to SS. Direct casting was successful in producing Be–Nb targets but not Be–SS owing to a low melting point eutectic in the Be–Cr–Fe–Ni system. Coextrusion of Be with SS was unsuccessful because of an unfavorable relationship between the thermal coefficients of expansion of the two materials in the desired configuration. Both brazing and diffusion bonding with silver as the intermediary material were moderately successful. (auth)

30692 (NLCO-923) SINK-REDUCTION OF HEAVY-WALLED STEEL TUBES. Herbert Davis and Herbert W. Hesselbrock (National Lead Co. of Ohio, Cincinnati). Dec. 7, 1964. Contract AT(30-1)-1156. 16p. (CONF-650431-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Association of Iron and Steel Engineers, Rolling Mill Conference, Birmingham, Ala.

The feasibility of using an industrial, three-roll, stretch-reducing mill for producing steel tubes in sizes equivalent to those of uranium fuel core blanks was successfully demonstrated. Heavy-walled steel tubes were reduced by sinking with light tension between stands and by stretching with heavy tension between stands. After rolling, the tubes could be machined to final dimensions with less stock removal than is required in the present core machining operation. (auth)

30693 (NUMEC-3432-9) IRRADIATION TESTING OF UO_2–PuO_2 FUELS. Quarterly Progress Report, January 1–March 31, 1965. William J. Ross, Ivor D. Thomas, and Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Pa.). Contract AT(30-1)-3432. 8p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The procedures used to prepare spherical particles of PuO_2–UO_2 mixtures, coat the particles with W, and incorporate them into a fuel element are described. (W.L.G.)

30694 (NYO-2784-9) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report, March 1965. (Nuclear Metals, West Concord, Mass.). May 20, 1965. Contract AT(30-1)-2784. 29p. (NMI-2138). Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Progress is reported in the fabrication of W–25 Re tubing. Promising results were obtained using moving-mandrel drawing followed by reeling. Measurements were made of the critical resolved shear stress in zone-refined Be single crystals with and without alloy additions. (W.L.G.)

30695 (NYO-2784-10) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Monthly Progress Report, April 1965. (Nuclear Metals, West Concord, Mass.). June 4, 1965. Contract AT(30-1)-2784. 6p. (NMI-2139). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Progress is reported on the fabrication of W–25 Re tubing and studies of the deformation of single-crystal zone-refined Be. (W.L.G.)

30696 (RDB(C)TM-278) THE MACHINING OF RARE METALS. C. R. Tottle and A. Smith (Industrial Group, United Kingdom Atomic Energy Authority, Culcheth (England)). Aug. 18, 1955. 5p. Dep.(mn).

An experimental investigation was conducted on the turning of the following rare metals: Ti, Zr, V, Nb, Ta, Mo, and W. The tool angles, turning speeds, feed speeds, and coolant that were found to be optimum for a smooth finish on each metal are tabulated. Tungsten carbide tools were used for all metals except Nb, with which high-speed steel could be used. The replacement of soluble oil and water as coolant by carbon tetrachloride was required for all but Ti. (D.L.C.)

30697 (RSIC-210) A SURVEY OF ELECTROFORMING FOR FABRICATING STRUCTURES. W. H. Safranek (Battelle Memorial Inst., Columbus, Ohio). Aug. 1, 1964. Contract DA-01-021-AMC-203(Z). 35p.

A survey of the use of electroforming for the fabrication of high-strength, complexly shaped structures is presented. The advantages and limitations of electroforming, the available property data of electroformed materials, and the electroforming conditions that must be maintained for good control of structural properties are discussed. (W.L.G.)

30698 (SGAE-CH-14/1964) DIE HERSTELLUNG SPHARISCHER KERNBRENNSTOFFTEILCHEN AUS SCHMELZEN UND SCHMELZSUSPENSIONEN. (The Preparation of Spherical Nuclear Fuel Particles from Melts and Suspensions). K. Knotik, H. Blidstein, P. Koss, G. Stolba, and Maerkl (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Chemie and Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Metallurgie). Dec. 1964. 18p. Dep.(mn)

Two methods that can be used for the production of spherical particles of uranium dicarbide or uranium–thorium dicarbide are described. The first is the preparation of spherical particles by spraying of a paraffin–melt suspension. The preparation of the suspension, the spraying technique, and the introduction of the melts into graphite powder beds were described. The second method is the preparation of spherical particles from droplet dispersed salt melts. The preparation of spherical particles from uranyl nitrate melts and from salt mixtures was discussed. (J.S.R.)

30699 (AD-611421) METHOD OF IMPREGNATING HIGH-MELTING METALS IN A GAS MEDIUM, FOR EXAMPLE, WITH ALUMINUM, SILICON AND ZIRCONIUM. B. N. Arzamasov and D. A. Prokoshkin. Translated from Russian Patent 148,318. Mar. 23, 1961. 5p. (FTD-TT-64-966; TT-65-61761). $1.00(fs); $0.50(mf) CFSTI.

A method is described for coating a high-melting metal with another metal such as Al, Si, or Zr. A carrier gas, HCl, is used to convert the powdered coating metal to the metal chloride. The coating metal is then deposited on the higher melting metal and the HCl gas recirculated. (W.L.G.)

30700 ACTIVITY COEFFICIENTS OF BERYLLIUM CHLORIDE IN MOLTEN BERYLLIUM CHLORIDE-SODIUM CHLORIDE. R. S. Sethi and H. L. Jindal (Univ. of Delhi). Current Sci. (India), 34: 284-5(May 5, 1965).

A fused salt system of beryllium chloride-sodium chloride was employed as a bath for electrolytic production of beryllium metal. The electrochemical behavior of this solvent was studied. The activity coefficients of beryllium chloride were found to be very low showing that it was highly complexed in solution with sodium chloride. (F.J.H.)

30701 CRYSTAL STRUCTURE OF TERNARY COMPOUNDS ScCoAl AND ScNiAl. M. Y. Teslyuk and V. S. Protasov (Lvov State Univ.). Dopovidi Akad. Nauk Ukr. RSR, No. 5, 599-601(1965). (In Ukrainian)

Roentgenostructural analysis was used to establish the existence of ternary compounds ScCoAl and ScNiAl with a structure of the type $MgZn_2$ and the following values of the lattice constants: for ScCoAl, a = 5.10 Å, c = 8.20 Å, c/a = 1.61; for ScNiAl, a = 5.12 Å, c = 8.20 Å, c/a = 1.60. (auth)

30702 DISPERSION FUEL ELEMENTS. PREPARATION AND CHARACTERIZATION OF FUELED BeO. I. Amato, R. L. Colombo, and A. M. Protti (FIAT, Turin). Energia Nucl. (Milan), 12: 326-9(June 1965).

A method for the optimization of BeO fueled pellets is described and their properties are reported. High density pellets of $BeO-UO_2$ were prepared by cold-pressing and sintering mixtures of BeO and UO_2 powders in different proportions. Grain growth was measured micrographically on sintered pellets of different compositions and obtained with different soaking times and temperatures. The presence of UO_2 was found to be effective in inhibiting grain growth. The limiting grain size in pure BeO is of the order of 40 μ. (P.C.H.)

30703 VAPO-METALLURGY. ARTICLE II. TUNGSTEN THERMIONIC EMITTER SURFACES IMPROVED BY CHEMICAL VAPOR DEPOSITION. N. D. McMurray, R. H. Singleton, K. E. Muszar, Jr., and D. R. Zimmerman (General Motors Corp., [Detroit]. J. Metals, 17: 600-5(June 1965).

The chemical vapor deposition of W by the H_2 reduction of WF_6 was studied over a wide range of deposition conditions. Preferentially oriented deposits were produced with either the (100) planes or the (111) planes parallel to the surface; resulting in uniform thermionic emission. The H_2-WF_6 mixture ratio was the most significant deposition parameter. (W.L.G.)

30704 RELATIONSHIP BETWEEN THE TEXTURE OF URANIUM PRODUCED BY SINTERING AND EXTRUSION AND ITS ELONGATION BY THERMAL ALPHA PHASE CYCLING. J. Peix and G. Cizeron (Ecole des Mines, Paris and CEN, Saclay, France). Mem. Sci. Rev. Met., 62: 323-35(Apr. 1965). (In French)

Grains having the preferred orientations of (100) and (110) were found in uranium rods produced by sintering and extrusion. There was a predominance of grains with the (100) orientation in the outer zones of the rods. An increase in the number of grains with (100) orientation decreased the deformation caused by thermal cycling. (W.L.G.)

30705 INFAB PROCESSING AND FABRICATION OF SPACE AGE MATERIALS. C. P. Mueller and L. M. Bianchi (Universal-Cyclops Steel Corp., Bridgeville, Penna.). Planseeber. Pulvermet., 13: 15-29(Apr. 1965).

The processing and fabrication of reactive and refractory metals have been on a continuous evolutionary curve. However, a revolutionary approach to optimizing the properties of these metals is available through InFab. This new facility permits the processing of the high-melting and reactive metals under ideal metallurgical conditions. Temperatures up to 4500°F, and total purity levels of 99.999% can be consistently attained. Within this revolutionary facility, the forging, rolling, and welding of all of the reactive and refractory metals are being re-evaluated. The results should lead to more reliable space age materials. (auth)

30706 GAS-IMPERVIOUS PROTECTIVE CASINGS FOR THERMO-COUPLES MADE OF ZIRCONIUM BORIDE. P. S. Kislly and M. A. Kuzenkova. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 1, 32-6(1965). (In Russian)

Thermocouple tips (casings) from the powder mixtures of ZrB_2 and 5 to 40 mole % Mo were fabricated by grinding and sintering in hydrogen medium at 1400 to 2000°C, furnace cooling to 1000°C, and subsequent air cooling. Optimum Mo concentrations and sintering temperatures were selected to provide for low porosity and gas impermeability. The life of thermocouple casings was tested during temperature measurement of liquid cupola cast iron. (Rev. Metal Lit., 22: No. 5, May 1965)

30707 THE KNIGHT SHIFT IN Nb–Sn PHASES AND ITS RELATION WITH TRANSITION TEMPERATURE. H. Luetgemeier (Siemens-Schuckertwerke AG, Erlangen, Ger.). Z. Naturforsch., 20a: 246-9(Feb. 1965). (In German)

On samples of the intermetallic phases Nb_3Sn, $NbSn_2$, and Nb_6Sn_5, the Knight shift of the nuclear resonance lines of ^{119}Sn was investigated in the range between –160°C and room temperature. Whereas $NbSn_2$ and Nb_6Sn_5 show a positive displacement independent of temperature, the Knight shift in Nb_3Sn is negative and has a strong temperature dependence. Samples of the Nb_3Sn phase with increasing transition temperature are differentiated from each other in the displacement: the preparations with the highest transition temperatures show the largest displacement and the largest temperature coefficients of the Knight shift. (tr-auth)

30708 INVESTIGATION OF THE CARBURIZING PROCESS IN TUNGSTEN CARBIDE HARD ALLOYS WITH COBALT AND NICKEL. I. N. Chaporova and E. A. Shchetlina. p.196-211 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

When powders of WC, Ni, and Co are sintered together, carburization tends to occur. Studies were conducted on the carburization of these metals at temperatures of about 1400°C. Carbon pickup and microstructure were examined. Sintering in a hydrogen atmosphere reduced carbon pickup. (Rev. Metal Lit., 22: No. 5, May 1965)

30709 THE APPLICATION OF ULTRA-FINE PARTICLES IN TUNGSTEN POWDER METALLURGY. P. R. Mundinger, H. H. Hausner, and W. H. Lenz (Los Alamos Scientific Lab., N. Mex.). p.20-7 of "New Types of Metal Powders." New York. Gordon and Breach Science Publishers, 1964.

Ultra-fine tungsten powder (3.7 m^2/g surface area), in amounts up to 25% was mixed with commercial tungsten powders of 2, 4.5, and 6.8 micron average particle size. When compacted at 60 tsi, the densities varied from 69% (of theoretical) for the 2 micron admixture to 76% for the 6.8 micron admixture. Upon sintering in hydrogen for three hours at 1700°C, the corresponding values were 92% and 80%. The highest sintered densities were obtained in every case with the largest addition of ultra-fine powder. The radial/axial shrinkage ratio of the compacts was found to correlate with the density increase during sintering. This ratio (varying from 0.80 to 1.86 for all the mixtures) decreased with increasing amount of densification for each series of specimens. (auth)

30710 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. George Edward Sheward and Peter Cameron (to United Kingdom Atomic Energy Authority). British Patent 980,395. Jan. 13, 1965. Filed Jan. 4, 1963.

A method is described for the manufacture of fuel elements of the externally finned type. A wire and associated brazing material are wound around a plain tubular sheath, and the wire-wound sheath is heated to effect brazing of the wire to the sheath. Various methods of effecting the combination of wire and brazing material are described. (B.L.M.)

30711 IMPROVEMENTS IN METAL STRIPS OR SHEETS AND THEIR METHODS OF MANUFACTURE. Lucien Alfille and Georges Duret (to Commissariat à l'Énergie Atomique). British Patent 980,526. Jan. 13, 1965. Priority date Oct. 13, 1961, France.

A method and apparatus are described for making a metallic strip suitable for spirally winding a fuel element by preparing a cylindrical workpiece from a metal whose crystalline structure has only one principal gliding plane. The working piece may be made of U, Zr, or Be or an alloy of one of these metals. The method also is applicable to Mg if the metal is heated to about 200°C when the strip is cut. The working piece is prepared by drawing so that the gliding plane at any point is parallel to the work piece, revolving the workpiece, and cutting a continuous strip from the workpiece by bringing the cutting edge of a cutting tool to bear on the surface of the revolving piece. The cutting edge of the tool is substantially parallel to the longitudinal axis of the workpiece. The tool is positioned so that the

depth of cut at any time is less than 0.2 mm. The angle between the plane tangential to the surface of the workpiece at the line where the tool bears on the workpiece surface and extending from the line in the direction of rotation and the leading face of the tool adjacent to the cutting edge is equal to or greater than 55°. The workpiece may be heated to a temperature sufficient to prevent weak zones but below the melting point during the cutting operation. (B.L.M.)

30712 IMPROVEMENTS IN OR RELATING TO URANIUM ALLOYS. Malcolm Stevens (to United Kingdom Atomic Energy Authority). British Patent 981,956. Feb. 3, 1962. Filed Apr. 19, 1962.

A method is described for producing U–Mo and U–Mo–Al alloys that have fine as-cast grain structures as a result of accelerated cooling rate. The cast U-Mo alloy containing 0.4 to 0.55 wt % Mo was subjected to cooling in the range of 75 to 300°C/min. The cast alloy containing U, 0.15 to 0.25 wt % Mo and 0.1 to 0.15 wt % Al was cooled at the same rate. The cast alloy members were suitable for inclusion in reactor fuel elements. (B.L.M.)

30713 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF SHEATHED ARTICLES. Albert Edgar Grant (to United Kingdom Atomic Energy Authority). British Patent 981,957. Feb. 3, 1965. Filed May 4, 1962.

A method is described for the production of sheathed articles that is particularly applicable to the production of fuel elements of uranium sheathed with magnesium-base alloys. The pre-formed sheath (e.g. magnesium-base alloy) is open ended and vertically supported while it is charged from below with a molten material (e.g. uranium) having a lower melting and fusing temperature than the material of the sheath. The temperature of the sheath is controlled by a heat sink during solidification of the first material. The heat sink includes a jacketed container adapted for having fluid coolant flow through it. The sheath may be deformed prior to charging with the melted or fused material so that after charging and solidification the materials are keyed against relative motion. An alloying material applied to the interior of the sheath before charging with the molten material will become bonded to the sheath after solidification. After solidification of the charging material, a forming process may be used to change the external configuration of the sheath. (B.L.M.)

30714 CARBON PRODUCTS WITH A PREDETERMINED DISTRIBUTION OF PORES. (to United Kingdom Atomic Energy Authority). British Patent 982,759. Feb. 10, 1965. Priority date June 15, 1961, France.

A method is described for making a carbon article having at least 80% of the total volume of the open pores of the finished article formed of pores having a predetermined range of diameters between dimensions a and b where a is any dimension between 0.03 and 1500 μ and b is between $3a$ and $10a$. The article is formed by subjecting a grist containing a certain proportion of specific sized carbonaceous particles to a forming process. The grist must contain 90% of the particles by weight having a diameter greater than a, from 50–70% by weight having a diameter greater than b, and about 15% by weight having a diameter between b and $20b$. (B.L.M.)

30715 FINNED TUBES. Leslie Charles Hackett and William Henry Laban (to Accles and Pollock Ltd.). British Patent 982,784. Feb. 10, 1965. Filed Dec. 31, 1962.

An apparatus and method are provided for forming tubes with one or more fins arranged in a variable lead helical formation. The apparatus includes means for advancing a tube having at least one external axially extending fin along a support. A die adapted to receive the fin is mounted on the support. The rotation of the rotatable die is controlled by means sensitive to the speed of the advancement of the tube and by means sensitive to the distance through which the tube has been advanced. The tube is heated before it is advanced through the die, and the part of the tube adjacent to the die is cooled by a blower head as the tube is advanced. (B.L.M.)

30716 IMPROVEMENTS IN OR RELATING TO COPYING LATHES. Charles Brebant, Victor Gerard, and Jean Martin (to Commissariat à l'Energie Atomique). British Patent 983,033. Feb. 10, 1965. Priority date June 15, 1962, France.

A copying lathe is described for the machining of radioactive materials within a hot cell. The lathe is mounted on a frame and includes a spindle whose rotation is controlled by a variable speed driving arrangement. A vertical carriage supporting a copying apparatus is arranged behind the axis of the spindle. Two parallel tubes arranged in a common vertical plane constitute slides for the carriage. A hydraulic assembly effects the longitudinal movements of the carriage on the tubular slides. Movements of a template on a support rotatable about a horizontal axis control the transverse movements with respect to the carriage of the copying apparatus. An intermediate tracer secured to the copying apparatus is directly responsible for the transmission of movement to the copying apparatus and hence to a tool carried by the copying apparatus. (B.L.M.)

30717 JOINT BETWEEN CARBON BODIES. (to Siemens-Planiawerke AG fur Kohlefabrikate). British Patent 983,590. Feb. 17, 1965. Priority date Mar. 29, 1961, Germany.

A gas and liquid-tight joint of carbon bodies is described in which a cylindrical opening in one body is fitted with a second carbon body in a force fit. The actual fit of the bodies at the region of the opening extends completely around the second body with no clearance. At least one of the bodies may have a recess containing a filler material to provide additional securing means. The filler material is a carbon material that expands during firing. This type joint is applicable to hollow graphite bodies, particularly tubular bodies enclosing a nuclear fuel element. (B.L.M.)

30718 MACHINE FOR DRILLING BOTH ENDS OF FUEL ELEMENTS USED IN NUCLEAR REACTORS. Emmanuel de Robien, Georges Fritz, Andre Lachambre, and Jean Claude Mettetal (to Commissariat a l'Energie Atomique). German Patent 1,182,758. Dec. 3, 1964. Priority date Feb. 5, 1962, France.

The machine consists of a vertically arranged cylindrical receptacle for the fuel elements, with two sliding carriages above and below the receptacle provided with closures for sealing the ends of the receptacle. Drilling devices pass through the closures of the receptacle. Pipes pass off the fluid contained within the drill casing of the fuel element. (Gmelin Inst.)

30719 METHOD OF PRODUCING URANIUM DIOXIDE WHICH CONTAINS ONE OR MORE OTHER ELEMENTS IN ITS CRYSTAL LATTICE. Erich H. P. Cordfunke (to Reactor Centrum Nederland). German Patent 1,183,062. Dec. 10, 1964. Priority date July 31, 1962, The Netherlands.

Pulverized or grained uranium trioxide dihydrate or an ammonium uranate is contacted with a solution that contains ions of the other elements to be introduced into the lattice. After this treatment the solid material is separated from the solution, dried, and reduced with hydrogen. (Gmelin Inst.)

30720 PRODUCTION OF URANIUM–CARBON ALLOYS. Jack Williams and Charles Brian Davis (to United Kingdom Atomic Energy Authority). U. S. Patent 3,162,528. Dec. 22, 1964. Priority date Sept. 8, 1959, Great Britain.

A method is described for the production of uranium-carbon systems of high density and low porosity. Plutonium may be included in the system if desired by replacing a part of the uranium in the starting material. Uranium metal powder and carbon powder are mixed together. The mixture is cold compacted and passed to a sintering zone maintained at 1000 to 1125°C. The temperature of the compact is allowed to rise rapidly in the sintering zone of a period of time of not more than 5 min as a result of the exothermic heat generated by the reaction at a rate greater than 100°C per min to a temperature between 1200 to 1450°C. Then the mixture is heated in the sintering zone at a tempera-

ture of about 1000 to 1125°C until sintering is complete. (B.L.M.)

30721 PROCESS OF MAKING NUCLEAR FUEL ELEMENT. Kenneth M. Taylor (to Carborundum Co.). U. S. Patent 3,166,614. Jan. 19, 1965. Filed Nov. 30, 1959.

A process is described for making a solid spherical fuel element particularly adapted for use in a pebble bed type reactor. The core of the element may contain, in addition to the fissionable material, particles of a refractory material to improve the thermal expansion characteristics of the element and/or moderator materials such as beryllium carbide. An impervious, external, refractory metal carbide cladding encases the core. The cladding is formed by coating the core with a porous outer layer deposited from a slurry containing at least one metal carbide selected from the group of SiC, TiC, or ZrC and a carbonaceous material and heating to cause a reaction between the carbonaceous material to form an additional metal carbide. If the moderator is not incorporated in the core, the core may be surrounded by a moderator layer applied in a similar manner prior to the application of the refractory coating. The ceramic moderator material is selected from the group C, Be, BeO, Be_2C, and mixtures of the C and Be_2C. (B.L.M.)

Properties and Structure

Refer also to abstract 31176.

30722 (AD-608146) THE USE OF STRAIN SOFTENING TO IMPROVE THE PROPERTIES OF REFRACTORY METALS. Quarterly Progress Report No. 3, June 1, 1964–August 31, 1964. E. J. Ripling and S. Zager (Materials Research Lab., Inc., Richton Park, Ill.). Contract NOw 64-0247-c. 10p. $1.00(CFSTI).

Attempts were made to reduce the scatter in bend angle measurements in both as-received and flexed Mo–0.5 Ti by two different surface treatments, viz., electropolishing and mechanical grinding. Neither of these were effective in reducing the scatter, however, implying that scatter results from a random internal distribution of flaws. Surface notches were applied to the bend test samples in order to introduce a flaw larger than the random ones occurring in the plate. This decreased the amount of scatter, but probably more important, the ductility at all testing temperatures was lowered so that a comparison of the flexed and as-received material was no longer limited by the angle of the punch. The introduction of the mild surface notch elevated the transition temperature 200-300°F. Flexing Mo–0.5 Ti plates was found to approximately double their notch bend ductility in both the longitudinal and transverse direction over much of the range of testing temperatures. (auth)

30723 (AD-608348) ELECTRICAL RESISTIVITY AND PHASE BOUNDARIES FOR THORIUM–CARBON ALLOYS (thesis). Frederick William Korbitz, Jr. (Iowa State Univ. of Science and Technology, Ames). 1964. 70p. $3.00 (CFSTI).

Electrical resistivity measurements were made on a series of thorium–carbon alloys. The electrical resistivities of ThC and ThC_2 at room temperature were found to be 115 ± 15 and 15 ± 2 microhm-cm respectively. The dicarbide undergoes two allotropic transformations, one at 1440 and one at 1490°C. These transformation temperatures were observed on carburized Th wires which had a thin layer of pyrolytic graphite on the surface. The trend of the transformation temperatures with decreasing C content, and hence the phase boundaries, was not definitely established. A reproducible resistivity discontinuity with temperature was observed at 1220 ± 20°C for alloys in the composition range between ThC and ThC_2. The size of the discontinuity appeared to be a maximum at the composition of Th_2C_3 suggesting the possible existence of this compound at temperatures above 1200°C and its decomposition into ThC and ThC_2 on cooling below 1200°C. The phase boundaries suggested by the resistivity data have been outlined in a tentative phase diagram. (auth)

30724 (AD-610658) SURVEY OF THE DEFORMATION CHARACTERISTICS OF TUNGSTEN. Monograph Series. George E. Gazza (Army Meterials Research Agency, Watertown, Mass. Metals and Ceramics Research Labs.). July 1963. 27p. (AMRA-MS-63-02). $2.00(CFSTI).

Results of basic investigations have shown that variable purity, microstructure, surface condition, and deformation rate will significantly affect the mechanical properties of tungsten, particularly near the ductile-brittle transition temperature range. From the standpoint of purity, oxygen and/or carbon appear to be particularly detrimental as interstitial contaminants. The effect of trace metallic impurities is unknown but is suspected to produce a significant effect in property variations. Thus far, the inability to correlate a specific impurity effect with a property variation has been due to the incapabilities of present analytical techniques at low impurity levels. Internal friction techniques are not without promise and they are expected to yield informative data on impurity effects in tungsten. The effect of surface condition on the mechanical properties has been already demonstrated. Both electropolishing and oxidation have a beneficial influence. (auth)

30725 (AD-614076) THE INVESTIGATION OF MICROSTRUCTURE IN STRUCTURAL CERAMICS. H. M. Burte and L. A. Jacobson (Air Force Materials Lab., Wright-Patterson AFB, Ohio). Jan. 1965. 32p. (AFML-TR-65-10; CONF-553-13). $2.00(CFSTI).

From American Ceramic Society 66th Annual Meeting Included Symposium on Nuclear and Space Applications, Chicago, Apr. 1964.

The importance of understanding and controlling the effects of microstructure on the properties of ceramics for space and nuclear applications has become well established in recent years. Attention is focused on defining pacing problems and the most fertile areas for future effort. This is attempted for the mechanical, thermal, and chemical properties underlying the structural use of ceramics. A dimensional range from subgrain features of polycrystalline bodies to the micromechanics of composites is considered. The status of experimental methods for characterizing microstructure is discussed, as is the importance of improved experimental substances. One pacing factor is the ability to synthesize or prepare desired microstructures with controlled variations, in order to further research into microstructural effects as well as to provide a basis for subsequent technology. (auth)

30726 (ARL-65-11) DIRECT STUDY OF DISLOCATIONS IN METALS BY TRANSMISSION ELECTRON MICROSCOPY-FATIGUE DEFORMATION. A. Lawley, J. D. Meakin, and K. U. Snowden (Franklin Inst., Philadelphia, Pa. Labs. for Research and Development). Jan. 1965. Contract AF33(657)-10360. 56p. CFSTI.

High-purity Mo single crystals were subjected to fatigue by cyclic loading in bend, axial tensile, and compression modes. The resultant dislocation substructure and surface slip structure were studied by both electron and light microscopy. Distributions of the dislocations and slip are discussed. The multiplicity of slip systems in Mo is attributed to the presence of a uniform fine scale precipitate. Transmission electron microscopic studies were made of the dislocation arrangement in Cu single crystals deformed by cyclic strain at slow cycle frequency. The results were compared with these for Al. The dislocation structures for various fatigue conditions are discussed. (D.L.C.)

30727 (BM-RI-6616) CRYSTALLOGRAPHIC MODIFICATIONS AND PHASE TRANSFORMATION RATES OF FIVE RARE-EARTH SESQUIOXIDES: LANTHANUM OXIDE, NEODYMIUM OXIDE, SAMARIUM OXIDE, EUROPIUM OXIDE, AND GADOLINIUM OXIDE. Stephan Stecura (Bureau of Mines, College Park, Md. College Park Metallurgy Research Center). Aug. 1964. 47p. Free (Bureau of Mines).

Crystallographic modifications and kinetics of solid-state phase transformations were determined for five rare-earth sesquioxides — La_2O_3, Nd_2O_3, Sm_2O_3, Eu_2O_3, and Gd_2O_3. Oxides used for crystal modification studies were

prepared by thermal decomposition of the following high-purity salts of the five rare-earth elements—carbonates, chlorides, fluorides, nitrates, oxalates, and sulfates. X-ray diffraction patterns of the cubic and hexagonal oxides were indexed by a graphical method and patterns of the monoclinic oxides by Ito's method. The kinetics of crystallographic transformation were determined by high-temperature x-ray diffractometry. The kinetic data were interpreted using a shrinking sphere model. All of the transformations followed first order kinetics. Activation energies were calculated by application of the Arrhenius equation. These solid-state phase inversions were concluded to occur by a reconstructive transformation mechanism. (auth)

30728 (BM-RI-6638) THERMOELECTRIC PROPERTIES OF DEPLETED URANIUM SELENIDES AND TELLURIDES. Lindsay D. Norman, Jr. (Bureau of Mines, Washington, D. C.). 1965. 20p. Free(Bureau of Mines).

Thermoelectric properties of depleted uranium selenides and tellurides were investigated from room temperature to 700°C. Several depleted uranium monoselenides and monotellurides were doped with selected cationic and anionic materials to determine the effect of impurity additions on the thermoelectric properties. The undoped uranium selenides and tellurides were semimetallic conductors exhibiting low Seebeck coefficients and electrical resistivities. Partial or complete degeneracy was in evidence, indicating a charge carrier energy distribution similar to that in a metal. Doping increased the Seebeck coefficients of the uranium monoselenides and monotellurides; however, the corresponding change in the power factor in the figure of merit was small because of the increase in electrical resistivity. (auth)

30729 (BNWL-22) INDEX—A COMPUTER PROGRAM FOR INDEXING X-RAY DIFFRACTION PATTERNS. J. B. Goebel and A. S. Wilson (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1965. Contract AT(45-1)-1830. 57p. Dep.; $3.00(cy), 2(mn) CFSTI.

Input data for this program are the 2θ reflections where θ is the Bragg angle as measured by a diffractometer from powdered crystalline samples. Additional data that may be supplied at the user's discretion are the x ray wavelengths, a possible error value, empirical gram formula weight and observed density. The program indexes the set of reflections on the basis of the cubic, hexagonal, tetragonal, and orthorhombic systems in that order. All lattice constants are calculated by an iterative least squares procedure. The printed output includes the crystal system, the lattice constants and their standard deviations, the wavelengths used, observed and calculated $\sin^2\theta$ values, and the difference between these latter two. An error term, E, is also printed as well as the number of formula units per unit cell in some cases. The value of E, the size of the lattice constants and their standard deviations, indicate to the crystallographer the validity of the indexing. The Miller indices are printed in the form $h^2 + k^2 + \ell^2$ in the cubic case, $h^2 + hk + k^2$ and ℓ^2 in the hexagonal case, $h^2 + k^2$ and ℓ^2 in the tetragonal case, and h^2, k^2, and ℓ^2 in the orthorhombic case. (auth)

30730 (CALT-221-8) THE STRUCTURE OF γ PHASE IN THE NIOBIUM–TIN SYSTEM. T. R. Anantharaman (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Mar. 1965. Contract AT(04-3)-221. 8p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The lattice spacings of the γ phase obtained from a $Nb_{60}Sn_{40}$ alloy were re-examined. Excellent agreement was obtained between experiment and theory on the basis of a face-centered tetragonal unit cell and a related smaller body-centered tetragonal unit cell. From the atomic volumes, the tetragonal γ phase is assigned the formula Nb_3Sn_7 and the composition 43–44 at. % Sn. (D.L.C.)

30731 (EUR-1819.e(p.37-48)) MULTIPHASE DIFFUSION STUDIES IN THE U–V–Al AND U–V–Si–Al SYSTEM. F. Casteels, J. J. Huet (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)), and R. Theisen (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

The electron microprobe was used to analyze the intermetallic compounds and their repartition in the diffusion bands of the U–V, V–Al, U–V–Al, and U–V–Si–Al heat-treated couples. The results are discussed relative to the diffusion barrier problem in ORGEL fuel elements. (D.L.C.)

30732 (EUR-1819.e(p.49-58)) MICROANALYSIS STUDIES OF BERYLLIUM. V. D. Scott and G. V. T. Ranzetta (Atomic Weapons Research Establishment, Aldermaston (England)).

The combined application of electron-probe microanalysis, electron microscopy, and electron diffraction in the study of corrosion and mechanical properties of Be is described. In corroded Be–Ca alloys, surface regions enriched with Ca were found using microanalysis. A segregation of Fe on the grain boundaries of annealed Be was indicated by both microanalysis and electron microscopy. (D.L.C.)

30733 (EUR-1819.e(p.63-89)) APPLICATIONS OF X-RAY MICROANALYSIS AND X-RAY PROJECTION MICRORADIOGRAPHY TO THE STUDY OF UNIRRADIATED AND IRRADIATED HIGH TEMPERATURE REACTOR FUELS. R. Theisen (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

Migration studies were conducted on coated carbide fuel particles. The results show that, at temperatures below 1700°C, U penetration proceeds along crystallite boundaries and coating defects. An effective diffusion barrier can be produced by a short-time annealing at 2000–2400°C. (D.L.C.)

30734 (EUR-1819.e(p.91-104)) THE INSTABILITY AND DIFFUSION PHENOMENA OF THERMAL TREATED PYROLYTIC CARBON COATED (U, Zr) C PARTICLES. F. Benesovsky, P. Stecher (Metallwerk Plansee, Reutte/Tyrol (Austria)) and R. Theisen (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

The stabilization of UC against carbon at high temperatures by ZrC is discussed. Electron-beam microanalysis was carried out on pyrographite-coated UC–ZrC solid solutions after heat treatments. The observed U and Zr concentrations in the coated particles of varying composition are given. (D.L.C.)

30735 (EUR-1819.e(p.145-70)) DETERMINATION DE LA SOLUBILITE DU PLUTONIUM DANS L'URANIUM α PAR ANALYSE PONCTUELLE A LA MICROSONDE DE CASTAING. (Determination of the Solubility of Plutonium in α Uranium by Castaing Pinpoint Microprobe Analysis). Michel Dupuy, Guy Moreau, and Daniel Calais (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

The solubility of Pu in U was determined as a function of temperature by observations on diffusion in couples prepared from pure U and a Pu–U alloy. The L and M emission spectra of Pu were also obtained by the use of the microprobe. (D.C.W.)

30736 (GA-5033) RESEARCH ON GRAPHITE. Annual Report, April 1, 1963–March 31, 1964. R. J. Price and J. L. White (General Atomic, San Diego, Calif.). Contract AT(04-3)-167. 102p. Dep.; $4.00(cy), 2(mn) CFSTI.

Progress is reported on the characterization of the microstructure of graphitic materials; the exploration of chemical and metallurgical methods for modifying the microstructure of graphite; and the investigation of the relation between microstructure and physical properties of graphitic materials. (W.L.G.)

30737 (HW-84573(p.6.1-11)) MATERIALS ENGINEERING. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

The unaged properties of Hastelloy X and W were determined and aging experiments are in progress. Inspections of the PRTR pressure tubes disclosed a new 15-mils-deep fretted area in the tube in Process Channel 1653. A new inspection schedule of about one-half the magnitude employed in the past several years is proposed. The third

report of information on postirradiation evaluation of Zircaloy-2 PRTR pressure tubes was written. The data presented indicate that the PRTR Zircaloy-2 pressure tubes have high strength with ductility, are resistant to crack propagation, have low notch sensitivity, and, generally, have low hydride concentration. The Irradiation Tube Testing Facility has operated continuously during the quarter on a program for evaluating irradiated Zircaloy-2 pressure tubing sections. A hydrided strip of Zircaloy-2 was connected to a direct current power supply to determine the effects of a direct current on ZrH. Metallographic studies indicate a small amount of hydride movement toward the negative end and a large movement of hydride from the hot center to the cool ends. (J.R.D.)

30738 (KAPL-3089) NOTCH SENSITIVITY OF UNIRRADIATED ZIRCALOY SUBJECTED TO BENDING FATIGUE. D. F. Mowbray (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 10, 1965. Contract W-31-109-eng-52. 24p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Fatigue-strength reduction factors (K_f) were determined for thick sections of wrought Zircaloy-4 and Zircaloy-4 weld metal. The experimental investigation was confined to determining K_f at 10^6 cycles and 600°F. The specimen loading method used for all tests was pure bending. Specimens were tested which had net section depths of 0.60 and 1.00 in., and notch root radii of 0.0007, 0.004, 0.012, and 0.030 in. The test results indicated that the weld metal was considerably more notch sensitive than the wrought metal. Maximum values of K_f found were ~3.0 for the wrought metal, and ~4.6 for the weld metal. These maximum values occurred at notch root radii greater than the smallest investigated. No increase in K_f was observed when the net section depth was increased from 0.60 to 1.00 in. The data obtained are compared with existing thin section notched bending test data and notch sensitivity factor (q) curves are established for both wrought and weld materials. Also, the δ concept for estimating the applicable K_f for crack-like defects was applied to the test results. It was found that δ cannot be treated as a material property for Zircaloy-4. (auth)

30739 (MCW-1491) EFFECT OF ALLOY ADDITIONS ON THE QUENCH-INDUCED TEXTURE OF ALPHA-URANIUM. K. R. Riggs and N. F. Newmann (Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.). Apr. 16, 1965. Contract W-14-108-eng-8. 44p. Dep.; $2.00(cy), 1(mn) CFSTI.

The effect of quench rate upon textures in dilute alloys of aluminum, chromium, iron, and silicon in uranium was studied. Inverse pole figure techniques for measuring orientation were applied to Jominy-type experiments. Proposed mechanisms for the introduction of preferred orientation by different cooling rates were developed. (auth)

30740 (NASA-CR-246) AN APPROACH TO METAL FATIGUE. F. B. Stulen, J. H. Redfern, and W. C. Schulte (Curtiss-Wright Corp., Caldwell, N. J.). June 1965. Contract NAS-1-3170. 85p. $3.00(CFSTI).

This investigation was undertaken to establish qualitatively and quantitatively some of those factors that are of primary importance in the fatigue of metals. For this investigation, the material used was titanium-8 Al–1 Mo–1 V alloy sheet in the Triplex-Annealed condition. This research program was limited to investigating three phases: (1) the fatigue limit associated with a crack; (2) the rate of crack propagation; and (3) the stress interaction effect, or the delay-cycle effect. Each of these effects is described by one or more proposed formulas, and the parameters associated with each were obtained by standard statistical methods. The rms error between the test data and the corresponding computed values was employed as a measure of the goodness-of-fit of the proposed formulas. Reasonably good fits were obtained between the test data and some of the proposed relations. A cumulative fatigue damage relation was developed based on these findings. (auth)

30741 (NP-15045) BIBLIOGRAPHY ON THE HIGH-TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE. January–March 1965, Volume 1965, Number 1. J. J. Diamond, ed. (National Bureau of Standards, Washington, D. C.). 60p. Free(NBS. Washington, D. C.).

A total of 589 references on the high-temperature chemistry and physics of materials in the condensed state, published during the period of 1963 to March 1965, are given. The materials are arranged according to whether they melt above or below 1500°C, if the measurement was made above or below 1000°C, and if the material is a metal, ceramic, or metal-ceramic mixture. References for devices for achieving, measuring, and controlling temperatures above 1500°C and for making physical measurements above 1000°C are included. (W.L.G.)

30742 (NYO-3087-4) CORRELATION OF PHYSICAL PROPERTIES OF CRYSTALS WITH MICROSTRUCTURE. Annual Progress Report, 1964–1965. J. Silcox (Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics). Contract AT(30-1)-3087. 5p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A brief summary is presented of the work carried out in the period June 1964 to May 1965. The topics studied included ferromagnetic properties of Ni and Ni alloys, coercivity of deformed Ni, magnetoresistance of Ni–Co alloys, and magnetic domains in permalloy. (D.L.C.)

30743 (NYO-3454-1) THERMAL, STRUCTURAL AND MAGNETIC STUDIES OF METALS AND INTERMETALLIC COMPOUNDS. Annual Report, May 15, 1964–May 15, 1965. W. E. Wallace and R. S. Craig (Pittsburgh Univ., Pa. Dept. of Chemistry). Contract AT(30-1)-3454. 115p. Dep.(mn); $4.00(cy), 3(mn) CFSTI.

Results of measurements of the electronic specific heat at 1.4 to 4.2°K and the magnetic susceptibilities and other magnetic properties at 1.4 to 300°K of a large number of intermetallic compounds and alloys are reported. (W.L.G.)

30744 (ORNL-3789(p.323-33)) PREPARATION OF PURE MATERIALS. (Oak Ridge National Lab., Tenn.).

Large single crystals of LiF of various isotopic compositions were produced with cationic impurity concentrations not exceeding 30 ppB. Distribution coefficients for Na^+, Mg^{2+}, Ca^{2+}, and Mn^{2+} on zonal melting of LiF show that the relative size of impurity ions markedly affects the rate of removal. A large (0.6 × 1.3 × 3.8 cm) single crystal of Tb metal was produced for ORNL research programs. By application of vapor-zone sublimation techniques, very pure polycrystalline ZrF_4 was produced; the Fe content of the commercial starting materials (550 ppM) was reduced to less than 100 ppM. (auth)

30745 (ORNL-TM-1080) EFFECTS OF PYROLYTIC-GRAPHITE STRUCTURE ON DIFFUSION OF THORIUM. Frederick Libben Carlsen, Jr. (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 101p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Thesis submitted to Univ. of Tennessee, Knoxville.

Diffusion coefficients for Th in pyrolytic-graphite specimens having a wide range of structural properties in the 1850 to 2000°C temperature range were determined. The specimens included pyrolytic graphites from two commercial sources, which were studied in the as-deposited or heat treated condition, and a pyrolytic graphite that had been hot pressed at 3000°C. The structures of the two as-deposited pyrolytic graphites were very similar as were the diffusion coefficients for Th diffusion in the direction perpendicular to the deposition plane. The pyrolytic graphite from one source had many microcracks parallel to the deposition plane resulting in a much higher diffusion coefficient in that direction. The structural changes that occurred during heat treatments at temperatures of 2200 to 2700°C did not reduce the diffusion coefficients of either material. The hot-pressed pyrolytic graphite had structural properties that were very close to those for ideal graphite, and the perpendicular-diffusion coefficient at 2000°C was less than 9×10^{-14} cm^2/sec. In this sample, the very large number of microcracks in the parallel direction resulted in a very large parallel-diffusion coefficient. The diffusion

process was found to be very dependent upon the concentration of Th. The diffusion coefficients measured when two micrograms of Th per cm^2 were placed on the samples, were approximately ten times lower than those measured using ten to thirty micrograms per cm^2. This concentration effect resulted in an apparent time dependence of the coefficients measured in thin-layer experiments. Autoradiographic studies showed that in +c-direction diffusion Th penetrates slightly deeper into the interior of the growth cones than it does at their boundaries. The penetration depth within the growth cones increases with the diameter of the cones. A qualitative mechanism that is consistent with the experimental observations was developed for the diffusion of Th in as-deposited pyrolytic graphite. (auth)

30746 (ORNL-TM-1124) HIGH-TEMPERATURE CREEP BEHAVIOR OF TYPE 304 STAINLESS STEEL IN ARGON–OXYGEN ENVIRONMENT OF DIFFERENT OXYGEN PARTIAL PRESSURES. P. Rodriguez (Oak Ridge National Lab., Tenn.). May 5, 1965. Contract W-7405-eng-26. 68p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Thesis submitted to Univ. of Tennessee, Knoxville.

Results of comparative creep studies on type 304 stainless steel in $Ar-O_2$ environments of various O_2 partial pressures at 815°C and 3400 psi are described. It was found that at low concentrations of O_2 (from none to seventy ppm) the creep rate of type 304 stainless steel decreases with increasing amounts of O_2 in the environment. Above seventy ppm, the creep rate of the material increased with increasing O_2 content, until a maximum creep rate was observed at 256 ppm of O_2. With further increases in O_2 content, the creep rate decreased again progressively. The influence of O_2 concentration in the environment on the creep-rupture behavior at 927°C and 2000 psi followed the same trend, the influence being manifested on the secondary creep rate as well as on the rupture life in the various environments. At low concentrations of O_2 the surface scales were very adherent and were identified as mainly Cr_2O_3. At higher concentrations (above seventy ppm of O_2) the surface film was of the spinel type and was found to be less adherent. The possibility is suggested that the strengthening effect at low concentrations is due to the adherent Cr_2O_3 film acting as a barrier for egress of dislocations, even though there has not been any conclusive evidence for such a strengthening effect due to surface films in polycrystalline specimens. A direct correlation was observed between the surface crack depth and creep rate in the various environments. The maximum crack penetration occurred in the environment giving the highest creep rate (256 ppm of O_2). Even though the surface crack density increased with higher concentrations of O_2 in the environment, the crack penetration was found to decrease. This indicates that the strengthening effect at high concentrations of O_2 is due to the influence of O_2 in retarding crack growth. The exact mechanism for this influence is not understood. (auth)

30747 (TID-21737) THERMAL CONDUCTIVITY OF LIQUID METALS OVER THEIR ENTIRE LIQUID RANGE, i.e., FROM MELTING POINT TO CRITICAL POINT, IN RELATION TO THEIR ELECTRICAL CONDUCTIVITIES AND THE FALLACY OF DIVIDING METALS INTO "NORMAL" AND "ABNORMAL" THERMAL CONDUCTING ONES. Aristid V. Grosse (Temple Univ., Philadelphia, Pa. Research Inst.). Dec. 7, 1964. Contract AT(30-1)-2082. 76p. Dep.(mn); $3.00(cy), 2(nm) CFSTI.

Metals are usually divided into "normal" and "abnormal" thermally conducting metals depending on whether their conductivity decreases or increases with rising temperature. Examples of the "normal" metals are sodium and potassium, while mercury is a typical representative of the "abnormal" ones; while sodium and potassium are "normal," their alloys—the well-known "NaK-alloys"—are "abnormal." It is shown that the above division is a fallacy. Using the recently found relation between the electrical conductivity of a liquid metal and its temperature over its entire liquid temperature range and the Wiedemann-Franz law, the thermal conductivities of the liquid metal, again over its entire liquid range, can be estimated. It is found that all or nearly all metals, except potassium and sodium, show the "abnormal" behavior. It is suggested to call this "abnormal" behavior regular from now on; thus, only potassium and sodium show irregular behavior. (auth)

30748 (UCRL-7729) SOME THEORETICAL AND EXPERIMENTAL ASPECTS OF DESIGN WITH BRITTLE MATERIAL. Ernest Y. Robinson (Lawrence Radiation Lab., Univ. of California, Livermore). Aug. 3, 1964. Contract W-7405-eng-48. 105p. Dep.; $4.00(cy), 2(mn) CFSTI.

Methods are presented for the evaluation of the requisite statistical parameters for a set of strength data for brittle materials. Aspects of design reliability are considered in relation to the classical safety factors and methods of successfully predicting the extreme values are established. The theory advanced by Weibull is reviewed and applied to an experimental study of the burst and bending strength of BeO. (L.B.S.)

30749 (UCRL-14132) A STRESS-CRACKING STUDY OF A GAMMA EXTRUDED U–8 w/o Mo–0.50 w/o Ti ALLOY. C. A. W. Peterson (Lawrence Radiation Lab., Univ. of California, Livermore). Apr. 15, 1965. Contract W-7405-eng-48. 13p. Dep.; $1.00(cy), 1(mn) CFSTI.

The U–8 wt Mo–0.50 wt % Ti alloy is subject to stress cracking in air during static or low strain-rate loading while in the metastable gamma-phase condition. The average critical stress is higher than the critical stress observed for the U–Mo binary alloy, but it is too low for the alloy to be acceptable for use under stress except in environments free from oxygen. However, if the alloy is transformed from the gamma phase to the alpha plus gamma condition, the stress-cracking brittleness disappears. The long term effect on the general corrosion resistance of the material by this heat treatment was not established. Homogenization of the duplex grain structure of this gamma-extruded alloy could be achieved only by drastic cold working followed by an anneal at gamma phase temperatures. The properties of this structure were not determined. (auth)

30750 (UCRL-16018) KINETICS OF VAPORIZATION OF ALUMINUM NITRIDE AND MAGNESIUM NITRIDE (thesis). Bette A. H. Blank (Lawrence Radiation Lab., Univ. of California, Berkeley). Apr. 23, 1965. Contract W-7405-eng-48. 45p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The kinetics of vaporization of aluminum nitride and magnesium nitride to metal gas atoms and nitrogen gas was studied, both in vacuum and in gaseous atmospheres of argon and nitrogen. An equation for $\log K_{eq}$ and the equilibrium total pressure of AlN sublimation as a function of temperature was found to be: $\log K_{eq} = \frac{3}{2} \log P_T - 0.3150 = -[(145.516 \pm 9.429)/45.76] (10^4/T) + 11.277 \pm 1.270$. The third-law and second-law enthalpies for the sublimation of aluminum nitride are 153.2 and 150.4 ± 9.4 kcal/mole, respectively. The third-law and second-law enthalpies of activation (ΔH^*_{298}) are 175.9 and 150.8 ± 12.1 kcal/mole, respectively. The second-law entropy and entropy of activation are 58.44 and 44.96 cal/°K/mole AlN, respectively. The $\log K_{eq}$ and total pressure of the decomposition of Mg_3N_2 to Mg gas atoms and N_2 gas can be expressed as a function of temperature by the following equation: $\log K_{eq} = 4 \log P_T - 0.9780 = -[(245.979 \pm 16.64)/45.76] (10^4/T) + 28.733 \pm 3.162$. The $\Delta H^\circ_{298} = 242.3$ by the third-law method, and 239.1 ± 16.5 kcal/mole by the second-law method. The ΔH^*_{298} (third law) = 286.3 kcal/mole, and 218.7 ± 12.9 kcal/mole by the second-law method. The second-law ΔS°_{298} and ΔS^*_{298} are 121.56 and 66.35 eu, respectively. The heat of formation of Mg_3N_2 calculated from our approximate equilibrium data is –136.8 kcal/mole. Evaporation of Mg_3N_2 in atmospheres of argon and nitrogen of pressures, which are of the order of magnitude of the sublimation pressure or greater, decreases the rate of evaporation. Nitrogen reduces the evaporation rate by about an order of magnitude more than does argon at the same background pressures. (auth)

30751 (WERL-8844-8) WELDING OF MONEL—CAST-PIN TEAR AND HOT-DUCTILITY TESTS. G. E.

Grotke, C. S. Williams, and F. C. Hull (Westinghouse Electric Corp., Pittsburgh, Pa.). Mar. 31, 1965. Contract NObs-78844. 72p.

Results are presented of the first application of the Cast-Pin Tear test and the Hot-Ductility test to the evaluation of the hot-cracking characteristics of Monel. Cast-Pin Tear tests of pure nickel–copper alloys with small amounts of additional alloy or impurity elements show that increased cast-condition cracking is associated with C, Fe, Mo, Nb, P, Pb, S, and Si, while improved performance is obtained with additions of Al, Ti, and V. Confirmation of the beneficial effect of vanadium was also obtained by additions to both commercial and high-purity Monel compositions. Hot-Ductility tests of four commercial Monels indicate that considerable impairment of elevated-temperature ductility is introduced by exposure to weld-zone thermal cycles. When these materials were tested during cooling in the temperature range 1200-1600°F, following brief exposure to a peak temperature of 2300°F, the reduction of area was roughly 40% of the original room-temperature value. Though the available hot-ductility test data for Inconel are extremely limited, the 1400°F on-cooling embrittlement of Monel appears to be more severe than that exhibited by either Inconel or by Type 347 stainless steel. (auth)

30752 (AI-Trans-83) THE HEAT CAPACITY OF TANTALUM IN THE TEMPERATURE RANGE OF 1200 TO 2900°K. Ya. A. Kraftmakher. Translated for Atomics International, Canoga Park, Calif., from Z. Prikl. Mekhan. i Tekhn. Fiz., No. 2, [158-60](1963). 8p. Dep.(mn); $1.00(cy), 1(mn) CFSTI:$1.10(fs), $0.80(mf) JCL.

The heat capacity of tantalum in the temperature range of 1200-2900°K was determined by the modulation method. In the temperature range of 1200-2000°K, a formula was proposed for the calculation of the heat capacity of tantalum. At higher temperatures, there is additional increase in the heat capacity due to formation of voids. The energy of formation and the voids concentration were calculated on the basis of test data. (auth)

30753 (AI-Trans-88) STUDY OF THE ELIMINATION BETWEEN 60 AND 200°K OF DEFECTS PRODUCED IN ALUMINUM BY ROLLING AT VERY LOW TEMPERATURE. C. Frois and O. Dimitrov. Translated by Anthony Cornell (Atomics International, Canoga Park, Calif.), from Mem. Sci. Rev. Met., 61: 753-60(1964). 16p. Dep.(mn); $1.60 (fs), $0.80(mf) JCL.

Samples of high-purity Al were cold-worked by rolling in liquid N_2 and liquid H_2. The results of electric resistivity measurements obtained during annealing at 60 to 210°K were used to study the elimination of the point defects produced during rolling. The kinetics and activation energies for the five stages of the recovery process were determined. (W.L.G.)

30754 (FTD-TT-64-1-297) INVESTIGATION OF THE RESISTANCE TO PLASTIC DEFORMATION ON THE PART OF CHROMIUM WITH MOLYBDENUM BY THE METHOD OF HOT HARDNESS. D. A. Prokoshkin, M. P. Matveeva (Matveyeva), and V. A. Morozov. Translated from Issled. po Zharoproch. Splavam, Akad. Nauk SSSR, Inst. Met., 7: 210-13(1961). 8p. CFSTI.

The effects of the Mo content on the hardness of Cr–Mo alloys at 400 to 1080°C are reported. The resistance to plastic deformation was measured at 1080°C by exerting a constant pressure on an indenter and measuring the change in the length of the diagonal of the impression as a function of time. The resistance to plastic deformation increased as the Mo content was increased from 0 to 40%. (W.L.G.)

30755 THERMODYNAMIC FUNCTIONS OF AN Fe–Mn SOLID SOLUTION FORMED BY THE Fe(n,p)Mn REACTION. R. Smith and R. Shuttleworth (Univ. of Leeds, Eng.). Acta Met., 13: 623-8(June 1965).

A dilute solution ($x_u = 3 \times 10^{-6}$) of manganese in iron was formed by neutron irradiation of natural iron $^{54}Fe(n,p)^{54}Mn$ and by means of the Knudsen effusion technique the quantity p_u/x_u, where p_u is the partial pressure of manganese, was estimated for temperatures between 1073 and 1673°K. The Raoultian activity coefficient was 0.3 and the variation with temperature was small corresponding to a partial heat of solution of 1.25 kcal/g-atom, (even though the cohesion energy of manganese is 33 kcal/g-atom less than that of iron). The value 0.3 arises from the positive excess entropy of solution. It is suggested that this excess entropy is primarily due to changes of the electronic specific heat of solution rather than changes in the lattice vibrations. (auth)

30756 PREFERRED ORIENTATIONS IN ALPHA URANIUM. J. J. Stobo, C. C. Robinson, and G. H. May (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). Acta Met., 13: 629-34(June 1965).

The orientation of grains in fiber-textured rods of α-phase grown by slow cooling transformation of uranium of various purities and histories have been determined by a Laue back-reflection technique. These results show that growth directions are always more than 60° from [100], are around [010] in pure uranium and move towards [001] with increasing impurity content (such as Fe, Al, C). A theory which predicts growth directions and which is based on the relief of transformation stress by vacancy collapse or climb is proposed and is shown to fit the results if (010) and (001) are the planes on which collapse or climb occurs. Since collapse on (001) produces a stacking fault the effects of impurity content on orientation are then due to changes in stacking fault energy. The importance of these ideas to fuel element technology is discussed. (auth)

30757 STRESS RELAXATION AND THERMAL ACTIVATION IN NIOBIUM. G. A. Sargent (Mellon Inst., Pittsburgh). Acta Met., 13: 663-71(June 1965).

Values of activation volume and energy have been determined for yielding, flow, and stress relaxation in high-purity polycrystalline niobium wire containing less than 100 ppm of interstitial impurities. It was found that within the scatter of the experimental results the values of activation volume as a function of the effective stress were the same for yielding, flow, and relaxation, suggesting that the same dislocation mechanism was rate controlling in all three cases. It was tentatively suggested that the dislocation mechanism that was rate controlling was either that of overcoming Peierls–Nabarro stresses, or that of the conservative motion of jogs. A new relationship was developed for the analysis of the stress relaxation data to account for relaxation in the tensile testing machine. (auth)

30758 THE HAFNIUM–OXYGEN SYSTEM. R. F. Domagala (Illinois Inst. of Tech. Research Inst., Chicago) and Robert Ruh. Am. Soc. Metals, Trans. Quart., 58: 164-75(June 1965).

Annealed and quenched specimens of arc-melted alloys were studied to construct the binary diagram from Hf to HfO_2 and from 700 to 2500°C. Additions of oxygen to Hf raised the α-β (hcp-bcc) transformation temperature (1775 ± 25°C) resulting in a peritectic reaction L (~1 at. % O) + α(~8 at. % O) → β(~3 at. % O) at ~2250°C. The α phase had a broad solubility for oxygen. The maximum solubility was positioned at 22 at. % O, decreasing to 20 at. % from 2000°C down to 700°C. The α phase was stabilized to its melting point, 2500°C. A eutectic existed where L(~37 at. % O) → α(~22 at. % O) + HfO_2 at ~2200°C. HfO_2 has a limited homogeneity range extending from ~66 to 66.7 at. % O. No metallographic evidence of the monoclinic-tetragonal inversion in HfO_2 was noted. The lattice parameters of specimens annealed at 1000°C indicated a solubility limit for oxygen in α at 18.6 at. %, in reasonably good agreement with the metallographically determined boundary. (auth)

30759 UVANITE, A SWELLING URANYL VANADATE WITH A LAYER STRUCTURE. Armin Weiss and K. J. Hilke (Universitet, Heidelberg). Angew. Chem. Intern. Ed. Engl., 4: 353(Apr. 1965).

The structural formula of uvanite, a rare, earth-like, brownish-yellow mineral, whould be written as follows: $M^+(H_2O)_x \cdot [UO_2 \cdot V_3O_8]^-$, of which the first portion represents exchangeable cations and swelling liquid and the

second portion an anionic layer lattice. It has not yet been possible to determine with certainty whether part of the water is attached to the trimetavanadate ion. In the formula given for the mineral in the literature, the exchangeable cations are neglected as impurities. The anionic layer lattice has a trigonal structure with a = 6.87 Å. It is decomposed by aqueous alkaline solutions. The unit cell contains only one formula unit. The cations M^+ can be interchanged with other cations, including primary or quaternary alkylammonium cations. The exchange capacity is ~177 mval per 100 g of mineral after drying at 110°C. The water content and basal plane spacing depend on the atmospheric humidity and the nature of the exchangeable cations in the sample. When alkylammonium ions are present, swelling also occurs with numerous polar organic compounds. The change in basal plane spacing with various n-alkyl amines is illustrated. The basal cell edge remains unaltered. The x-ray diffraction pattern contains only (hk) bands, which tail off toward large angles (cross-lattice interferences), and (001) reflexes. (BBB)

30760 APPLICATION OF A NONMAGNETIC STEEL AND OF WEAK DEGASSING FOR CONSTRUCTION OF A NUCLEAR APPARATUS. Souchet, R. Bull. Cercle Etudes Metaux, 9: 155-76(Dec. 1963). (In French)

The requirements on the vacuum system for an electron storage ring are summarized; and the results of an investigation of the magnetic properties, transformation under welding, degassing, fusion under vacuum, polishing, and vacuum characteristics of stainless steels containing C, Cr, and Ni are presented. (D.C.W.)

30761 ENTHALPY DIFFERENCE OF HEXAGONAL AND RHOMBOHEDRAL GRAPHITE. H. P. Boehm and R. W. Coughlin (Universitat, Heidelberg). Carbon, 2: 1-6 (Aug. 1964).

An isothermal calorimeter was developed for measuring the heat of formation of potassium graphite, C_8K. The observed heat of reaction was -84.1 ± 0.3 cal/g°C using pure hexagonal graphite, but -88.1 ± 1.1 cal/g°C using graphite containing 33% rhombohedral modification. From these results it was calculated that 0.14 ± 0.04 kcal/g-atom is liberated on transition of rhombohedral into hexagonal graphite. Only by mechanical treatment, such as grinding, can the rhombohedral modification be outlined. Estimation of the energy stored in the lattice defects produced by grinding led to values significantly lower than those measured. (auth)

30762 THE DIMENSIONAL CHANGES PRODUCED IN GRAPHITE BY ABSORPTION OF BROMINE. J. E. Brocklehurst and R. A. Bishop (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Carbon, 2: 27-39(Aug. 1964). (TRG-Report-552)

In general, polycrystalline graphites have substantially lower volume coefficients of thermal expansion than the crystallites of which they are composed. It was previously suggested that this was because microporosity, oriented parallel to the layer planes, absorbs part of the c-axis expansion of the crystallites. If this is true then the volume expansion of polycrystalline graphite when it absorbs bromine should also be lower than that of the crystallites and there should be a correlation between linear thermal expansion and initial linear growth per unit bromine concentration. The dimensional changes of a wide variety of polycrystalline graphites, when they absorb bromine, were investigated and the correlation between initial growth per unit concentration of bromine and thermal expansion coefficient was demonstrated. It was also observed that when the strain of the crystallites in the c-axis direction becomes large the orientated microporosity fills up. When this happens the volume growth of the polycrystalline graphites per unit concentration of bromine approaches that of the crystallites. At even higher crystallite strains in the c-axis direction, anisotropic polycrystalline materials tend to expand faster than the crystallites and this is considered to be caused by the generation of additional porosity. This effect is less marked in the isotropic polycrystalline graphites. The relation between growth due to bromination and dimensional changes produced by fast neutron irradiation is discussed. Data on the effect of graphitization temperature on the subsequent dimensional changes produced by bromination are also described. (auth)

30763 CALCULATIONS OF THE FORMATION ENERGY OF VACANCIES IN GRAPHITE CRYSTALS. C. A. Coulson and M. D. Poole (Mathematical Inst., Oxford). Carbon, 2: 275-9(Dec. 1964).

Calculations were made of the loss of π-electron resonance energy when a single carbon atom is ejected from an infinite graphite layer. This confirmed a previous less reliable value 2.75 β. The possibility that, after the original carbon atom is ejected, its three neighbors change their electronic structure from trigonal $sp^2\pi$ hybridization to something closer to a divalent s^2p^2 condition is discussed. Ignorance of the numerical values of certain quantities prevented a final decision; but it appeared a little unlikely that this occurs. It is shown that when two single vacancies in the same plane unite to form a divacancy, there is an amount of energy released, which probably lies in the range 4 to 6 ev. In the course of these calculations it is shown that the loss of π-electron energy when 1, 2, or 4 carbon atoms are removed from a layer is $2.75 \pm 0.01\ \beta$, $4.52 \pm 0.01\ \beta$, and $8.65 \pm 0.04\beta$, respectively. (auth)

30764 STRUCTURAL AND HIGH TEMPERATURE PROPERTIES OF BORON PYROLYTIC GRAPHITE. W. V. Kotlensky and H. E. Martens (California Inst. of Tech., Pasadena). Carbon, 2: 314-17(Dec. 1964).

Tensile data on boron pyrolytic graphite, when compared with that on many lots of pyrolytic graphite, showed that over the range from room temperature to 2200°C, there is not a marked difference between the tensile strengths of these two types of material. The fracture elongation at 2200°C appeared to be slightly greater for boron pyrolytic graphite than for the pyrolytic graphites. At 2480 and 2760°C the fracture elongation of boron pyrolytic graphite was much higher than for any lot of pyrolytic graphite previously measured. The room-temperature structural property changes, which were observed both after heating and after heating and straining were taken. After heating at temperatures up to 3000°C, and after heating and straining at temperatures up to 2200°C, only slight changes were found in the structure as measured by preferred orientation and degree of graphitization. However, after large deformations at 2480 and 2760°C, the changes are very marked, and the preferred orientation indicated that the basal planes are almost perfectly aligned with respect to the stress direction. The boron pyrolytic graphite showed a strain-induced structural transformation at 2480°C, which is not typical for pyrolytic graphites. There was some evidence that heating caused some loss of boron. (F.J.H.)

30765 CRYSTALLOGRAPHIC STUDY OF THE INTERMETALLIC COMPOUNDS T_2Co_7 AND TCo_5 (T = RARE EARTH). Erwin Felix Bertaut, Remy Lemaire, and Jacques Schweizer (Centre d'Etudes Nucleaires, Grenoble, France and Laboratoire d'Electrostatique et de Physique de Metal, Grenoble, France). Compt. Rend., 260: 3595-7(Mar. 29, 1965). (In French)

The structures of the compounds Gd_2Co_7 and $HoCo_3$, crystallizing in the rhombohedric group $R\bar{3}m$, were established. They are closely bound to the structure of TCo_5 (T = rare earth). The compound TCo_4 announced by various authors does not exist. It is, in fact, a mixture of TCo_5 and T_2Co_7. (tr-auth)

30766 KINETICS OF THE BETA → ALPHA TRANSFORMATION OF PURE PLUTONIUM. Roger Galerne and Bernard Spriet (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Compt. Rend., 260: 3961-4(Apr. 5, 1965). (In French)

The transformation kinetics of the β-phase of Pu were followed by measurements of the resistivity. The sketch of the TTT diagram shows that, following the temperature, the $\beta \rightarrow \alpha$ transformation proceeds by one or two distinct mechanisms. The values of the activation energy, close to that for the self-diffusion in one case (11 kcal/mole) and very weak in the other (2.6 kcal/mole), suggest a transformation by diffusion and by shearing, respectively. (tr-auth)

30767 COMPOUNDS WITH STRUCTURES OF THE AlB_2 TYPE IN THE SYSTEM Ce–Ni–Si AND IN RELATED SYSTEMS. E. I. Gladyshevskii and O. I. Bodak (Lvov State Univ.). Dopovodi Akad. Nauk Ukr. RSR, No. 5, 601-4(1965). (In Ukrainian)

The roentgenostructural method was used to establish the existence of 15 compounds $R(Me, X)_2$ where R = La, Ce, Pr, Nd, Sm, Me = Fe, Co, Ni, Cu, and X = Si, Ge, possessing structures of the AlB_2 type (space group P6/mmm–D_{6h}^1). The lattice periods are tabulated. (auth)

30768 PROPERTIES OF NIOBIUM ALLOYS PREPARED BY ELECTRON-BEAM MELTING. I. S. Malashenko (Paton Inst. of Electric Welding, Kiev). Fiz.-Khim. Mekhan. Materialov, 1: No. 1, 67-72(1965). (In Russian)

The mechanical characteristics of a series of Nb alloys prepared by the method of electron-beam fusion were investigated. It was found that the effectiveness of the alloying constituents W, Mo, Zr, and V is increased according to the complexity of the alloy composition. Mo in comparison with W to a great extent decreases the plastic properties of Nb. Alloys of Nb with 8 to 9 at. % W combines satisfactorily low-temperature plasticity and stability at 1100 to 1200°C. Zr and V together with W and Mo appear as necessary components for the formation of high-stability Nb alloys for the combination of high-temperature stability. In the future preparation of Nb alloys it will be necessary to develop multi-component alloying matrices under conditions limiting its impurities. (tr-auth)

30769 CHANGE OF BERYLLIUM DISTRIBUTION OCCURRING WHEN MAGNESIUM ALLOYS CONTAINING BERYLLIUM ARE SUBJECTED TO HEAT. Ichikawa Riei and Saito Reiko. Keikinzoku, 68: 79-85(Nov. 1964). (In Japanese)

Magnesium and alloys with 1% Al, Ca, La, Th, Zn and 0.002 to 0.024% Be were heated to 300, 400, and 500°C in air, argon, and vacuum. Chemical analyses were made for Be distribution on surface and various depths. Oxidation was measured by weight increase. Surface Be distribution was found related to oxidation. (Rev. Metal Lit., 22: No. 5, May 1965)

30770 ELASTICITY AND INTERNAL FRICTION OF POLYCRYSTALLINE YTTRIUM OXIDE. M. O. Marlowe and D. R. Wilder (Ames Lab., Ames, Iowa). J. Am. Ceram. Soc., 48: 227-33(May 1965). (IS-792)

Young's modulus and internal friction of polycrystalline yttrium oxide were determined from room temperature to 1658°C by sonic techniques. A linear relation was found between volume fraction porosity and Young's modulus at room temperature. The effect of porosity on room-temperature internal friction is also discussed. Young's modulus decreased linearly with increasing temperature to 1000°C. From 1000 to 1100°C, a slight anomaly was observed accompanied by an internal friction peak. The modulus was again linear from 1100 to 1350°C. Above this temperature a rapid decrease in elastic modulus occurred with a rapid increase in internal friction. (auth)

30771 HIGH-TEMPERATURE THERMOPHYSICAL PROPERTIES OF ZIRCONIUM CARBIDE. Leonard N. Grossman (General Electric Co., Pleasanton, Calif.). J. Am. Ceram. Soc., 48: 236-42(May 1965).

An apparatus based on the method of Jain and Krishnan was developed for property measurements in the temperature range from measurable radiant emission to the thermal stability limit of metallic materials. Apparatus and experimental techniques for cylindrical specimens with length-to-diameter ratios >4 are described. The theory of the method is reviewed, practical formulations are developed, and error sources are analyzed. The following properties were determined for ZrC in the range 1000 to 2500°K: thermal conductivity, spectral thermal emittance at 0.65μ, spectral thermal emittance at 0.65μ as a function of time in vacuum, electrical resistivity, and total thermal emittance. A compilation of experimental values for other physical properties of ZrC is given. (auth)

30772 THE SYSTEM ZIRCONIUM–CARBON. R. V. Sara (Union Carbide Corp., Parma, Ohio). J. Am. Ceram. Soc., 48: 243-7(May 1965).

Phase relations in the system zirconium–carbon were established by DTA, and metallographic methods. Only one phase, a monocarbide with the NaCl structure, was found. The low-carbon phase boundary for the monocarbide contains 38.5 at. % carbon between 1900 and 3300°C. The carbon-rich boundary between 2850 and 3300°C is at 48.9 at. % carbon. ZrC melts congruently at 3420°C and 46 at. % carbon. The lattice parameter versus composition curve shows a maximum at 46 at. % carbon. The Zr–ZrC eutectic is at 1860°C and 1 at. % carbon; the Zr–ZrC eutectic is at 2850°C and 65 at. % carbon. Liquidus curves are inferred from the invariant points. (auth)

30773 PHASE EQUILIBRIA IN THE SYSTEM TUNGSTEN–CARBON. R. V. Sara (Union Carbide Corp., Parma, Ohio). J. Am. Ceram. Soc., 48: 251-7(May 1965).

Quenching from high temperatures, supplemented by differential thermal analysis, has shown that the tungsten–carbon binary is characterized by eutectic temperatures of 2710°C between W and W_2C, and 2760°C between W_2C and a new high-temperature phase (β-WC). Carbon solubility in excess of stoichiometric W_2C is evident only at 2525°C, the eutectoid temperature between W_2C and WC. $W_{2.35}C$ melts congruently at 2795°C. A new fcc phase (β-WC), stable only above 2525°C, has been discovered between W_2C and α-WC. The cubic phase is formed by a peritectic reaction at approximately 2785°C and has a broad homogeneity range near the solidus. The phase, α-WC, decomposes into β-WC and C at 2755°C, approximately 25°C below the melting temperature. (auth)

30774 Fe–Ta OXIDES: PHASE RELATIONS AT 1200°C. A. C. Turnock (Dept. of Mines and Technical Surveys, Ottawa). J. Am. Ceram. Soc., 48: 258-61(May 1965).

Subsolidus phase relations of the oxides in the system Fe–Ta–O were experimentally determined at 1200°C, 1 atm total pressure, and variable partial pressures of oxygen. Tantalum pentoxide reacts readily with either ferrous or ferric oxide at subsolidus temperatures and the following ternary compounds have been synthesized: $Fe_4Ta_2O_9$, $Fe_3Ta_2O_{8.1}$, $FeTaO_4$, $FeTa_2O_6$, solid solutions between the latter two compounds, and tantalian magnetites. The compositions of solid solutions between $FeTaO_4$ and $FeTa_2O_6$ were very sensitive to variation of oxygen pressure. This sensitivity explains the oxidation behavior of tapiolite. The incorporation into magnetite of up to 7 at. % Ta was demonstrated, with a resulting increase in the size of the unit cell and decrease in magnetic permeability. (auth)

30775 VAPOR-DEPOSITED BORIDES OF GROUP IVA METALS. J. J. Gebhardt and R. F. Cree (General Electric Co., Valley Forge, Penna.). J. Am. Ceram. Soc., 48: 262-7(May 1965).

The formation of vapor-deposited TiB_2, ZrB_2, and HfB_2 at 1400°C was studied with respect to the influence of process variables on structure and stoichiometry. Stoichiometric, nonporous deposits of TiB_2 were obtained; ZrB_2 and HfB_2 deposits contained β-rhombohedral boron. Precision lattice parameters were determined for the three diborides. The effect of codeposited boron on these parameters appeared to be slight. A small degree of preferred orientation existed in materials made under these conditions, indicating that crystallites tend to be deposited with c axes parallel to the substrate. Grain size, orientation, porosity, and stoichiometry are influenced and therefore should be controllable by process variation. (auth)

30776 SOLID SOLUTIONS IN THE SYSTEM URANIA–RARE EARTH OXIDES: I. UO_2–$GdO_{1.5}$. R. J. Beals and J. H. Handwerk (Argonne National Lab., Ill.). J. Am. Ceram. Soc., 48: 271-4(May 1965).

The extent and nature of solid solution formation in the system urania–gadolinia were investigated. Compositions sintered in hydrogen, in argon, and in air were analyzed by chemical and x-ray methods. Extensive solid solution exists between uranium dioxide and gadolinium sesquioxide. Some

anomalies in the lattice parameters of the solid solutions are interpreted. (auth)

30777 A STUDY ON THE EMANATION METHOD APPLIED TO NUCLEAR FUEL IN THE SYSTEM UO_2-ZrO_2-CaO. Sumino Ichiba (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 163-7(May 1965).

Radioactive rare gas captured in solid powder by fission recoil was successfully used as tracer for emanation method studies to observe continuously the monoclinic-tetragonal transformation of zirconia, the stabilization of zirconia with calcia, the formation of a solid solution of calcia-stabilized zirconia with uranium dioxide, and the oxidation behavior of solid solutions formed between uranium dioxide and 15 mole % calcia-stabilized zirconia. The results clearly confirmed the information so far reported. (auth)

30778 FISSION GAS RELEASE FROM URANIUM HEATED IN CARBON DIOXIDE. STUDY ON THE BEHAVIOR OF PUNCTURED FUEL ELEMENT FOR CALDER HALL TYPE REACTOR. [PART] 3. Kiyoaki Taketani (Japan Atomic Energy Research Inst., Tokyo) and Katsuichi Ikawa. J. Nucl. Sci. Technol. (Tokyo), 2: 168-71(May 1965).

An experiment to predict the amount of fission gas release from U heated in CO_2 was made in connection with the safety evaluation of the Tokai Atomic Power Reactor. Fission gas release from slightly irradiated U pieces was measured as a function of percent oxidation, and it was found that the percent release was proportional to the percent oxidation. The fission gas released before the U was completely oxidized was 11, 23, and 48% at 500, 600, and 700°C, respectively. The form of temperature dependence of the fission gas release was of the Arrhenius type, with an activation energy of 5.1 kcal/mole. (auth)

30779 SURFACE AREA MEASUREMENT OF VIBRATORY COMPACTED UO_2 FUEL. Tadashi Kubota (Mitsubishi Atomic Power Ind. Inc., Omiya-shi, Saitama-ken, Japan). J. Nucl. Sci. Technol. (Tokyo), 2: 172-7(May 1965).

The surface area of vibratory compacted UO_2 fuel specimens was measured from the low temperature adsorption of krypton gas. The n-layer B.E.T. equation, with n-value in the range $2.0 \sim 3.5$, was found to be best suited for adsorption isotherms of vibratory compacts. For approximate calculation, Hüttig's equation was found to be better than either ∞-layer B.E.T., L.G.D. or H.J. equations. Specific surface areas of dense UO_2 vibratory compacts (over 85% T.D.) were found in the range $0.340 \sim 0.450$ m^2/g. (auth)

30780 INFLUENCE OF DANCOFF EFFECT ON TEMPERATURE COEFFICIENT. Kazuko Yamamoto and Tsunetaka Wajima (Hitachi Central Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 200(May 1965).

It is pointed out that the Dancoff effect on the temperature coefficient has a positive contribution, and that the magnitude of the effect is about 10%, that is, larger than that on the resonance escape probability itself, which is about 1.5%. Examples are given for UO_2-H_2O, $W-UO_2$, and a single rod. The closer the lattice, the larger the Dancoff effect. (P.C.H.)

30781 PLASMA OSCILLATION OF ELECTRONS IN ALLOY. II. Ag–Au ALLOY. Osamu Sueoka (Tokyo Univ.) and Fuminori Fujimoto. J. Phys. Soc. Japan, 20: 569-73 (Apr. 1965).

The characteristic electron energy loss spectra of Ag–Au alloy were studied at various compositions using the Möllenstedt-Watanabe-type analyzer at 30 kev. The energy spectra do not show remarkable change in range of composition considered. The energy loss due to the plasma oscillation decreases continuously from 3.5 ev to 2.65 ev with increase in the Au concentration. Comparison with the results of optical measurements shows that the 2.65-ev loss in pure Au involves only the surface plasma. (auth)

30782 ALFVÉN WAVES IN BISMUTH. B. W. Faughnan (Labs. RCA, Inc., Tokyo). J. Phys. Soc. Japan, 20: 574-91 (Apr. 1965).

Alfvén wave transmission at 52.6 Bc was observed and studied for all the principal directions of bismuth. The results agree fairly well with theory based on either the one-fluid model or the plasma dielectric constant, and two modes are observed in the general case. The field at which the Alfvén wave propagation is attenuated was studied in terms of the appropriate cyclotron resonance term in the conductivity tensor. For the case of propagation parallel to the bisectrix axis, transmission is possible down to at least 750 gauss because the heavy hole cyclotron resonance is not excited. The Doppler shift in this cut-off field is also calculated. When thin samples were used, evidence was found for "split modes" for some orientations. The origin of this effect was not studied in detail. Finally, an attempt was made to observe "giant quantum oscillations" at T = 1.8°K, but none were observed. (auth)

30783 RESISTANCE ANOMALY AND RESIDUAL RESISTIVITY OF DILUTE La-RARE EARTH ALLOYS. Tadashi Sugawara, Ikuyo Yamase, and Ryukichi Soga (Tokyo Univ.). J. Phys. Soc. Japan, 20: 618(Apr. 1965).

The resistivity of a number of dilute alloys of La containing rare earth metals was measured at low temperatures in order to study the scattering of conduction electrons by the localized 4f electrons. The resistivity of the alloys, except Ce–La, decreases gradually down to the superconducting transition temperature, while the resistivity of Ce–La has a minimum slightly above the transition temperature. The values of the effective s-f exchange integral for rare earths in beta La were determined. The exchange integral for Ce in La is negative, while those for the other rare earths are positive. (D.C.W.)

30784 INFLUENCE OF OXYGEN CONTENT AND NITROGEN CONTENT ON THE PROPERTIES OF ZIRCALOY-2. M. Armand, J.-P. Givord, P. Tortil, and G. Trolliet (S.E.C.E.M. et A.E.U. Laboratoire de Recherches, Venthon, France). Mem. Sci. Rev. Met., 62: 275-83(Apr. 1965). (In French)

Oxygen had a strong hardening effect on the mechanical properties of Zircaloy-2 at room temperature. This effect decreased as the temperature increased; becoming very small above 400°C. Nitrogen had an effect approximately 2.5 times that of oxygen, which also decreased with increasing temperature, but at a lower rate. (W.L.G.)

30785 SYSTEMS FORMING BETWEEN NIOBIUM ANHYDRIDE AND IRON OXIDES. A. Burdese and M. Lucco Borlera (Istituto di Chimica Generale ed Applicata e di Metallurgia Politecnico, Turin). Met. Ital., 57: 150-5 (Apr. 1965). (In Italian)

Phase studies were made of the $Fe_2O_3-Nb_2O_5$, $FeO-Nb_2O_5$, and $Fe-Nb-O$ systems. In the $Fe_2O_3-Nb_2O_5$ system, phases of Fe_2O_3-49 Nb_2O_5, Fe_2O_3-25 Nb_2O_5, and Fe_2O_3-9 Nb_2O_5 with the Nb_2O_5 structure, and $FeNbO_4$ with both rutile and columbite type structures, were identified. In the $FeO-Nb_2O_5$ system, phases of $FeO-34$ Nb_2O_5, $FeO-18$ Nb_2O_5, and $FeO-7$ Nb_2O_5 with the Nb_2O_5 structures, and $FeNbO_4$ with both rutile and columbite type structures, and Nb_2O_5-4 FeO with the hematite type structure, were identified. It was found that Fe^{II} and Fe^{III} are capable of replacing Nb to form phases of the $NbO_{2.48}$, $NbO_{2.46}$, and $NbO_{2.40}$ types. (W.L.G.)

30786 ALUMINUM–BERYLLIUM ALLOYS. I. N. Fridlyander, K. P. Yatsenko, Z. G. Semenova, and G. A. Nekrasova. Metalloved. i Term. Obrabotka Metal., No. 3, 2-5(Mar. 1965). (In Russian)

The only possible way of increasing the modulus of elasticity is to add a significant amount of an element such as beryllium which has a high modulus of elasticity (E = 31,000 hg/mm^2). Al-Be alloys with a high content of brittle Be are plastic, because the Al matrix is plastic. Two types of Al-Be alloys having high strength and high modulus of elasticity were prepared. Alloys containing 15 to 60% Be with up to 15% of other alloying constituents show a tensile strength

of 40 to 60 hg/mm^2, an elongation of 8 to 20%, and a modulus of elasticity of 10,000 to 18,000 hg/mm^2. These alloys were strengthened by thermal treatment. Another group of Al-Be alloys was strengthened by thermal treatment, and contains 15 to 40% Be with up to 10% of other alloying ingredients. These alloys have a tensile strength of 52 to 69 hg/mm^2, an elongation of 8 to 12%, and a modulus of elasticity of 11,500 to 14,500 hg/mm^2. The non-strengthened alloys have a higher plasticity than the strengthened alloys. The Al-Be alloys maintain their strength at higher temperatures. Thus, the strength is 43 to 55 hg/mm^2 at 20°C, 30 to 36 hg/mm^2 at 200°C, 20 to 34 hg/mm^2 at 300°C, 12 to 16 hg/mm^2 at 400°C, and 3 to 8 hg/mm^2 at 500°C. (TTT)

30787 THE CRYSTAL STRUCTURE OF $TaNi_2$. H. Oesterreicher and H. Nowotny. Monatsh. Chem., 95: 1038-9(Oct. 21, 1964). (In German)

Fabrication of $TaNi_2$ was done by melting, annealing at 1300°C, and tempering at 700°C. Lattice parameters were measured by x-ray powder diffraction. A structure isotypical to $MoSi_2$ was found. (Rev. Metal Lit., 22: No. 5, May 1965)

30788 COMPOUNDS OF THE T_5M_3X TYPE. W. Jeitschko, H. Nowotny, and F. Benesovsky. Monatsh. Chem., 95: 1242-6(Oct. 21, 1964). (In German)

Fabrication was done by sintering of T:M:X = 5:3:1 alloys where T stands for a transition metal, M for a metal, and X for a non-metal. Investigation was made by X-ray diffraction of alloys of the filled Mn_5Si_3-type. The following phases were investigated: $Nb_5Ga_3C_x$, $Nb_5Ga_3N_x$; $Nb_5Ge_3C_x$, $Nb_5Ge_3N_x$, $Ta_5Ge_3C_x$, $Ta_5Ga_3N_x$, $Ta_5Ge_3C_x$, $Ta_5Ge_3N_x$ and $Mo_5Ge_3C_x$; crystal structure and lattice parameters were determined. (Rev. Metal Lit., 22: No. 5, May 1965)

30789 THERMAL SIMULATION TEST ON VIBRATORY COMPACTED UO_2 FUEL. [PART] I. STRUCTURAL CHANGE. Tadahide Nohara, Tadashi Kubota, Shozo Fujinaga, and Shuichiro Takahashi (Mitsubishi Atomic Power. Ind. Inc., Japan). Nippon Genshiryoku Gakkaishi, 7: 241-7 (May 1965). (In Japanese)

In-pile thermal behavior of vibratory compacted UO_2 fuel was simulated by center-line heating method. The microstructure of vibratory compacts, while retaining the as-compacted state in the peripheral region, assumed an aspect more and more similar to pressed and sintered pellets toward the fuel center, due to sintering. Lenticular voids, larger than those found in pressed and sintered pellets, were found in the columnar grain region. Circumferential cracking produced by rapidly rising center temperature was found to occur in short discontinuous stretches, unlike the very distinct cracks seen in sintered pellets and swaged compacts. (auth)

30790 TRANSIENT TEMPERATURE DISTRIBUTIONS IN CYLINDRICAL FUEL-ELEMENT END CAPS. Benjamin M. Ma (Iowa State Univ., Ames). Nucl. Struct. Eng., 1: 443-8(May-June 1965).

The transient temperature distributions in bonded end caps of solid cylindrical fuel elements subjected to sudden change in temperature were determined analytically. The solution for the temperature distributions is expressed by products of Bessel functions, exponential functions, and coupling relations between the end cap and the fuel section of the fuel element. A numerical example is given for enriched uranium dioxide dispersed fuel elements with Zircaloy-2 cladding and bonded Zircaloy-2 end caps. From the calculated results of the example several conclusions were drawn. (auth)

30791 THE HIGH TEMPERATURE TERMINAL SOLUBILITY OF CARBON IN MOLYBDENUM, TUNGSTEN, AND RHENIUM. E. Fromm and U. Roy (Max-Planck-Institut fur Metallforschung, Stuttgart). Phys. Status Solidi, 9: K83-5(1965).

Cylindrical specimens of Mo, W, and Re were carburized in a carbon crucible at constant temperature for extended periods, sufficient to reach homogeneous carburization in the core of the specimen. The experimental method was previously described. The resultant values for the terminal solubility as a function of temperature are shown and are compared with other experimental results. (L.B.S.)

30792 THE EFFECT OF AN ARGON ENVIRONMENT ON THE DIFFUSION OF Co^{60} IN MOLYBDENUM. J. Askill (Oak Ridge National Lab., Tenn.). Phys. Status Solidi, 9: K113-16(1965).

Anneals were carried out in argon and in a vacuum for the diffusion of ^{60}Co in Mo and the samples were analyzed by both serial sectioning and by autoradiography. The resulting diffusion coefficients are tabulated and an Arrhenius plot is shown. The effect of the argon atmosphere on the diffusion anneals was found to be temperature dependent. It decreases the lattice diffusion coefficients by a factor which varies from 6.3 at 1850°C to 2.8 at 2350°C and also considerably increases the amount of grain boundary diffusion. (L.B.S.)

30793 INTERSTITIAL ORDERING OF CARBON IN TANTALUM. R. E. Villagrana and G. Thomas (Univ. of California, Berkeley). Phys. Status Solidi, 9: 499-518 (1965). (UCRL-11782(Rev.))

The effect of interstitial carbon on the structure of tantalum was investigated by transmission electron microscopy and diffraction. Interstitial ordering was found, and the ordered structure was determined from computation and comparison with electron diffraction data. The superlattice structure is tetragonal, with a c/a ratio of 1.128, and an ideal composition of $Ta_{61}C$. Since the superlattice was determined from thin foils, it was necessary to compare the thin foil results with bulk specimens, alloyed to correspond to $Ta_{61}C$. Microscopic examination of bulk specimens showed many domain boundaries, separating regions in which the tetragonality associated with ordering was oriented in different directions. An analysis of these domain boundaries indicates that there are three possible types: coherent, semicoherent, and antiphase. (auth)

30794 STUDY ON THE ALLOY BEHAVIOR OF BORIDES IN THE TERNARY SYSTEMS CERIUM-THORIUM (URANIUM)-BORON. P. Stecher, F. Benesovsky and H. Nowotny (Metallwerk Plansee AG, Reutte/Tirol, Austria and Universitat, Vienna). Planseeber. Pulvermet., 13: 37-46(Apr. 1965). (In German)

The B–Ce–Th and B–Ce–U systems were investigated by x-ray methods on sintered specimens produced from powdered cerium hydride. Partial phase diagrams of the systems cerium–boron and thorium–boron were established on the basis of melting point determinations and metallographic findings. CeB_6 and ThB_6 are characterized by intense color. In the ternary system Ce–Th–B, the tetra- and hexaborides, respectively, form continuous series of solid solutions at 1600°C. The interaction parameters between the thorium and cerium tetra- and hexaborides can be calculated from tie line positions. In the ternary system Ce–U–B, only the tetraborides form solid solutions, while the other boride phases do not show mutual solubility. (auth)

30795 METAL POWDER MAGNESIUM AND MAGNESIUM–BERYLLIUM ALLOYS. V. E. Ivanov, V. F. Zelenskii, S. I. Feifer, S. M. Zhdanov, V. I. Maksimenko, and V. I. Savchenko. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 5, 46-53(May 1965). (In Russian)

Data are presented on the results of development of metal powder magnesium alloys with magnesium oxide and high-temperature magnesium-beryllium alloys. Introducing a slight quantity of finely dispersed oxide into the magnesium leads to a marked strengthening. A typical feature of the metal powder compositions of magnesium–magnesium oxide is the stability of their strength properties. Magnesium–beryllium alloys are distinguished by stable and long resistance to high-temperature oxidation. The resource of long high-temperature alloys is determined by the quantity of beryllium in the alloy and rises with the increase in beryllium content. (auth)

30796 SUPERZONE BOUNDARY EFFECTS IN THE ELECTRICAL RESISTIVITY OF DYSPROSIUM. M. D.

Wilding and E. W. Lee (Sheffield Univ., Eng.). Proc. Phys. Soc. (London), 85: 955-61(May 1965).

The effects of superzone boundaries on the electrical resistivity of dysprosium were studied by measuring the magnetoresistance of two crystals of dysprosium with the field applied in the basal plane. The maximum effect occurs parallel to the c axis and amounts to some 15%. The results are in agreement with the conclusions of Elliott and Wedgwood that the predominant effect is produced by superzone boundaries whose planes are perpendicular to the c axis. Some evidence for the presence of superzone boundaries whose planes are at an angle to the c axis is provided by a small magnetoresistance in the basal plane, attributable to the destruction of the superzone boundaries. (auth)

30797 THE MAGNETIC SUSCEPTIBILITY AND ELECTRICAL RESISTIVITY OF YTTRIUM. W. E. Gardner, J. Penfold, and M. A. Taylor (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 85: 963-6(May 1965).

The magnetic susceptibility and electrical resistivity of yttrium metal were measured below 300°K. The susceptibility of yttrium increases from $186 \pm 5 \times 10^{-6}$ emu (g atom)$^{-1}$ at 293°K to $195 \pm 5 \times 10^{-6}$ emu (g atom)$^{-1}$ at 10°K. The susceptibility results disagree completely with the recent measurements of Chechernikov. In addition, no anomaly in either the susceptibility values or the resistivity values is evident at about 170°K. (auth)

30798 THE FIRST-ORDER RAMAN SPECTRUM OF CALCIUM TUNGSTATE. J. P. Russell and R. Loudon (Royal Radar Establishment, Malvern, Eng.). Proc. Phys. Soc. (London), 85: 1029-33(May 1965).

The lattice-vibration Raman spectrum of calcium tungstate was measured, using excitation by a He–Ne laser. Eleven of the thirteen long-wave-length phonon modes which are Raman active in first order were detected. Polarization studies have revealed the group-theoretical symmetries of ten of the phonons. The linewidths and relative intensities of the Raman peaks were also measured. These results complement the information obtained from the infra-red reflection spectrum of calcium tungstate. The frequencies of the infra-red and Raman active phonons are discussed in terms of the normal modes of the lattice. (auth)

30799 THE INFLUENCE OF STRONTIUM AND LANTHANUM ON SOME PROPERTIES OF LEAD ZIRCONATE AND LEAD TITANATE SOLID STATE SOLUTIONS. Wladyslaw Kaminski (Zaklad Ceramiki Radiowej, Warsaw). Przeglad Elektron., 6: 80-3(Feb. 1965). (In Polish)

The research on the effects of additives to solid state solutions of lead zirconate and lead titanate is directed at increasing the stability for possible utilization as resonators in filter circuits. The results of investigations are presented for the following compounds: $Pb_{0.94}Sr_{0.06}(Zr_xTi_{1-x})O_3$ with and without 5% La_2O_3, by weight. All results were compared with a standard of $Pb(Zr_xTi_{1-x})O_3$. The electrical properties were studied as a function of percentage Zr. The effect of strontium dilution of the lead is qualitatively equivalent to dilution of the titanium with zirconium, and both substitutions lead to an intensification of the favorable electrical properties. The addition of La_2O_3 adds significantly to the time stability of the electrical properties, i.e., it retards aging. (TTT)

30800 INFLUENCE OF THE FORMING METHOD OF MICROSTRUCTURE AND MECHANICAL PROPERTIES OF URANIUM. J. A. Stohr. Tech. Mod., 56: 393-402(Oct. 1964). (In French)

High-purity uranium and two low-alloy uraniums (Fe–Al–Si–U and Mo–U) were formed by gravity casting, using hot and cold molds with and without vibration, centrifugal and injection casting, and by hot extrusion and hot rolling from billets. The forming methods used, coupled with suitable heat treatment to provide the fine grain structure required for fuel elements, all produced shapes of virtually the same mechanical properties. Effects of the methods on surface and internal defects were also studied. (Rev. Metal Lit., 22: No. 5, May 1965)

30801 EFFECT OF URANIUM ADDITIONS ON THE BEHAVIOR OF CARBON AND SULFUR IN AUSTENITIC STAINLESS STEELS. M. Kawabata. Tetsu To Hagane, 49: 1543-5(1963).

The hot workability impaired by sulfur and transgranular corrosion stemming from carbon precipitated as chromium carbide are discussed. Specimen compositions was: 0.03 to 0.23% C, 18 Cr, 12 Ni, 0.034 to 0.115 S, and 0 to 1.5 U. Changes in hardness and microstructure during annealing were observed. Effects of temperature and uranium content on occurrence of a eutectic structure at the grain junctions and on the mechanical properties and age hardening were studied. Resistance to transgranular corrosion was observed as a function of the uranium content. Fixation of sulfur in low-Mn austenitic stainless steel by uranium and its effect on hot shortness were determined. (UKAEA)

30802 EFFECT OF URANIUM ON THE MECHANICAL PROPERTIES OF 28% Cr, 15% Ni HEAT-RESISTING CAST STEELS. Sh. Inoue. Tetsu To Hagane, 49: 1569-71(1963).

Some 28% Cr, 15 Ni, 0.35 C, and 1.3% Si heat-resisting cast steels with 0, 0.05, 0.08, 0.13, 0.25, and 0.5% U added were studied. Data on U recovery and segregation are presented. Tensile properties at room temperature and at 1100°C (2010°F) were determined. Creep-rupture test data at 1100°C were also studied. Hardness of the austenitic matrix and factors contributing to the improved strength of U-alloyed steels are discussed. (UKAEA)

30803 URANIUM ADDITIONS TO LOW-ALLOY, HIGH-STRENGTH STEELS. M. Hasegawa and I. Onoda. Tetsu To Hagane, 49: 1541-3(1963).

Cleanliness, hardenability, and transition temperature are discussed. Composition and austenite grain size of Si–Mo, Mo–B, and Cr–Ni–Cu steels were studied. Room-temperature mechanical properties, uranium recovery, forgeability, and nonmetallic inclusions were determined. Effects of uranium on as-annealed structure and hardness, on low-temperature notch toughness, and on secondary hardening of the steels were determined and the reaction mechanism involved was studied. (UKAEA)

30804 EFFECT OF URANIUM ADDITIONS ON THE BEHAVIOR OF NITROGEN IN AUSTENITIC STAINLESS STEELS. M. Kawahata. Tetsu To Hagane, 50: 722-4(1964).

Changes in microstructure, mechanical properties, and corrosion resistance were observed. The steel composition used was low carbon, 18% Cr, 12% Ni, 0.025 to 0.126% N_2, and up to 1% U. Microstructure in the annealed condition was observed. Mechanical properties as affected by nitrogen and uranium were studied. X-ray diffraction analyses were made of isolated residues from as-annealed specimens. The presence of UO_2 and the deoxidizing power of uranium, effects of uranium additions on pitting corrosion, and changes in microstructure after prolonged holding at temperature were found. (UKAEA)

30805 EFFECT OF CRYSTALLOGRAPHIC ORIENTATION ON THE FRACTURE DUCTILITY OF Zr-2.5 Wt Pct Nb(Cb) AND ZIRCALOY-2 TUBULAR PRODUCTS. B. A. Cheadle and C. E. Ells (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Trans. Met. Soc. AIME, 233: 1044-52(June 1965).

The orientation of hexagonal α-Zr crystals in cold-drawn Zircaloy-2 tubes and in both as-extruded and heat-treated Zr–2.5 wt % Nb tubes was measured using the inverse pole-figure technique. Uniaxial tensile tests have shown the Zircaloy-2 tubes to have highly anisotropic deformation behavior whereas heat-treated Zr–2.5 wt % Nb tubes are nearly isotropic. The differences in deformation behavior are explained from the observed textures of the tubes and the deformation systems known to operate in Zircaloy-2. The results lead to an explanation of the high effective strain observed for the Zircaloy-2 tubes as compared to heat-treated Zr–2.5 wt % Nb tubes in restrained end burst tests at 280 to 300°C. (auth)

30806 THE RATES OF NUCLEATION AND GROWTH OF ALPHA URANIUM TRANSFORMED FROM THE BETA IN DILUTE URANIUM–CHROMIUM ALLOYS. A. Bar-Or.

P. Wynblatt, and G. Hirsch (Israel Atomic Energy Commission, Tel-Aviv). Trans. Met. Soc. AIME, 233: 1100-4(June 1965).

The rates of nucleation and growth at various temperatures in U-0.45, 1.1, and 1.35 at. % Cr alloys were determined, providing a quantitative proof that the transformation under study is controlled by nucleation and diffusional growth. The linear relation, log $\dot{N}v$ vs $1/\Delta T^2$, suggests that the nucleation of the alloys is probably controlled by the classical law of nuclei formation. The established linear relation, log G vs $1/\Delta T$, in the three alloys suggests that growth in each alloy is controlled by bidimensional nuclei formation. It was established that both the rate of growth and the rate of nucleation are retarded by chromium. Using classical formula, σApN and σApG (the β/α apparent interphase energies) were calculated from the nucleation and growth results, respectively. It was found that their values are of the same order of magnitude. However, why σApN is unaffected by the addition of chromium, while σApG increases with it, needs further clarification. (auth)

30807 THE EFFECT OF THORIA ON THE ELEVATED-TEMPERATURE TENSILE PROPERTIES OF RECRYSTALLIZED HIGH-PURITY TUNGSTEN. G. W. King and H. G. Sell (Westinghouse Electric Corp., Bloomfield, N. J.). Trans. Met. Soc. AIME, 233: 1104-13(June 1965).

An investigation was made of the tensile properties of recrystallized high-purity tungsten and a W-1% ThO_2 dispersed-phase alloy over the temperature region of 800 to 2400°C. The thoria addition resulted in a modest strengthening effect over the entire temperature region. A decrease in ductility of both materials occurred above 0.5 T_m which was caused by void formation. Current theories of strengthening by a dispersed second phase do not adequately explain the tensile results. Metallographic examination suggests that the improved strength of the alloy results from the effect of thoria on the microstructure. Stress-dependent thermally activated processes were found to occur at high temperatures. (auth)

30808 LITHIUM ALLOYING AND DISLOCATION MECHANISMS FOR PRISMATIC SLIP IN MAGNESIUM. A. Ahmadieh (Univ. of California, Berkeley), Jack Mitchell, and J. E. Dorn. Trans. Met. Soc. AIME, 233: 1130-8(June 1965).

A detailed investigation of the dislocation mechanisms controlling prismatic slip in α solid solutions of Mg containing up to 15.9 at. % Li revealed that low-temperature prismatic slip is controlled by the Peierl's mechanism for all alloy compositions. At higher temperatures slip in the 7.9 at. % Li alloy was found to follow the dictates of the cross-slip mechanism from basal to prism planes, while the higher-Li alloys exhibited an athermal deformation process which might be due to short-range ordering. The major effect of Li additions on the low-temperature shear stress for prismatic slip appears to be due to its effect in lowering the Peierl's stress whereas an increase in the shear stress with increased Li content at higher temperatures might be due to short-range order strengthening. Additions up to 7.9 at. % Li appear to have only minor effects on the stacking-fault energy. (auth)

30809 TWINNING IN COLUMBIUM–VANADIUM ALLOYS. D. O. Hobson, J. O. Stiegler, and C. J. McHargue (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 233: 1138-45(June 1965). (ORNL-P-936)

The effects of alloy composition, deformation temperature, heat treatment, and interstitial contamination on the occurrence of deformation twins were studied. The twinning transition temperature varied with composition and was a maximum of 140°C for the 40 wt % V composition. The temperature range of the transition was very narrow. Alloys of 20 to 70 wt % V could be cold-rolled and exhibited profuse twinning. The alloys which did not twin at room temperature (10, 80, and 90 wt % V) could not be cold-rolled. Oxygen additions systematically lowered the transition temperatures for all V contents. The transition temperature for a 30 wt % V alloy increased with annealing temperature, apparently due to changes in dislocation density and configuration. Twinning did not nucleate fracture in any specimen in the 20 to 60 wt % V composition range. (auth)

30810 A THERMODYNAMIC ANALYSIS OF THE Cr–C–O, Mo–C–O, AND W–C–O SYSTEMS. Wayne L. Worrell (Univ. of California, Berkeley). Trans. Met. Soc. AIME, 233: 1173-7(June 1965). (UCRL-11609)

Thermodynamic data for the stable carbides and oxides of chromium, molybdenum, and tungsten were critically evaluated and were used to determine the stable condensed phases at 1 atm total pressure in each metal-carbon-oxygen system. Pourbaix-Ellingham diagrams were constructed and were used to estimate the minimum temperatures necessary to obtain these metals by carbothermic reduction under reduced pressures. (auth)

30811 THE EFFECT OF DISSOLVED NITROGEN ON THE ELECTRICAL RESISTANCE OF NIOBIUM (COLUMBIUM). R. A. Pasternak and B. Evans (Stanford Research Inst., Menlo Park, Calif.). Trans. Met. Soc. AIME, 233: 1194-6(June 1965).

The resistivity of Nb was measured as a function of N_2 concentration and temperature. The resistivity increased linearly with N_2 concentration at constant temperatures of 25 and 1130°C and linearly with temperature for constant concentrations. (W.L.G.)

30812 THE THERMOELECTRIC PROPERTIES OF TANTALUM ALLOYS. D. J. Maykuth, R. H. Ernst, and H. R. Ogden (Battelle Memorial Inst., Columbus, Ohio). Trans. Met. Soc. AIME, 233: 1196-7(June 1965).

The hypothesis was proposed that the addition of valency electrons from metals in groups VI, VII, or VIII to metals of groups IV and V would progressively increase the thermoelectric power output. When the number of valency electrons per atom reaches six, the maximum electronic bond stability is achieved as is the peak thermoelectric power output. The metals Ti, Nb, Mo, and W were alloyed with Ta and the emf relative to W–^{26}Re measured as a function of temperature. The emf curve for Ta was shifted by the various alloying additions in the directions predicted by the hypothesis, but it was apparent that these changes were not a simple function of the electron: atom ratio. (W.L.G.)

30813 PHASE TRANSFORMATIONS IN DISSOCIATION OF β–UO_3 AND γ–UO_3. A. R. Beketov, V. G. Vlasov, and V. N. Strekalovskii. Zh. Neorgan. Khim., 10: 737-40 (Apr. 1965). (In Russian)

On the basis of x-ray and kinetic methods of analysis the scheme of phase transformations in the dissociation processes of β and γ UO_3 is proposed. The mechanism is $\beta, \gamma > UO_3 \rightarrow U_3O_{8+x_{max}} \rightarrow U_3O_8$. In the range of solid solutions on the basis of uranous oxide–uranic oxide with excess oxygen, calculation of the parameters of the elementary cell was made in dependence on the composition. The character of the modification of the density by dissociation of γ–UO_3 is explained. It was assumed that the solid solution showed defects in both sub-lattices of the uranic oxide phase. (tr-auth)

30814 NEW TYPES OF METAL POWDERS. Proceedings of a Symposium Sponsored by the Powder Metallurgy Committee, Institute of Metals Division, The Metallurgical Society, American Institute of Mining, Metallurgical, and Petroleum Engineers, Cleveland, Ohio, October 24, 1963. Metallurgical Society Conferences, Volume 23. Henry H. Hausner, ed. New York, Gordon and Breach Science Publishers, 1964. 174p. (CONF-631004). $3.95 (paper); $9.50 (cloth).

A separate abstract was prepared for one of the ten papers included. The remaining papers cover the characteristics, production, metallography, and applications of metal powders. (W.L.G.)

For an abstract of the individual paper see: 30709.

30815 DYNAMIC STRENGTH OF WC–Co CERMETS AT HIGH TEMPERATURES. A. I. Baranov. p.149-56 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

A method is described for determining impact strength

of VK6 cermets at temperatures in the range 20 to 1200°C. Details of equipment for the technique are given. Impact toughness was influenced by the grain size of the WC phase and by temperature. (Rev. Metal Lit., 22: No. 5, May 1965)

30816 THE EFFECT OF THE COOLING CONDITIONS AND PHASE COMPOSITION OF WC–Co HARD ALLOYS ON THE DECOMPOSITION OF A SOLID SOLUTION OF TUNGSTEN AND CARBON IN COBALT. V. I. Tret'yakov, I. N. Chaporova, and E. D. Samoilova. p.157-64 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

Powders of WC and Co were sintered together. Cooling was accomplished at different rates from water quenching to furnace cooling. Solid solutions of W and C did not decompose in Co even at very slow cooling rates. WC crystals apparently were instrumental in accelerating the decomposition process. (Rev. Metal Lit., 22: No. 5, May 1965)

30817 INVESTIGATION INTO THE MODE OF NUCLEATION AND GRAIN GROWTH IN A SOLID SOLUTION OF TUNGSTEN CARBIDE IN TITANIUM CARBIDE WHEN MIXTURES OF THEIR POWDERS ARE SINTERED. V. I. Tret'yakov and I. N. Chaporova. p.179-91 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

Sintering of WC and TiC powders was carried out in a Mo wound furnace at 1550°C. The microstructure of the solid solution alloy produced was examined by etching microsections. Grain size, diffusion, nucleation, grain growth, and microstructure of the solid solution were studied. (Rev. Metal Lit., 22: No. 5, May 1965)

30818 CHANGE IN THE DIMENSIONS AND SHAPE OF THE GRAINS IN A TiC–WC SOLID SOLUTION WHEN HEATED IN THE PRESENCE OF FREE TUNGSTEN CARBIDE, AND TUNGSTEN AND COBALT CARBIDE. G. S. Kreimer and M. R. Vakhovskaya. p.192-5 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

Powders of TiC and WC were heated at temperatures ranging from 1500 to 2000°C for 2.5 hr. Specimens were examined by microscopy after heating. Specimens were also heated in the presence of free WC, W, and CoC. Grain growth in the alpha phase was found to be dependent on temperature of heating and amounts of WC, W, and CoC. (Rev. Metal Lit., 22: No. 5, May 1965)

30819 INVESTIGATION OF THE MOSAIC STRUCTURE OF TUNGSTEN BY ELECTRON MICROSCOPY. N. P. Vasil'eva, T. A. Sultanyan, and I. N. Chaporova. p.240-9 of Hard Metals Production Technology and Research in the U.S.S.R. New York, Macmillan Co., 1964.

Electron microscopy was used to investigate the submicrostructure of powdered W produced by H reduction of tungstic anhydride at 900 and 1200°C and specimens of compact W produced by fusing small presintered W rods. Equipment used in the preparation is described. (Rev. Metal Lit., 22: No. 5, May 1965)

Radiation Effects

See also CHEMISTRY — Radiation Chemistry.

Refer also to abstracts 30762, 31184, and 31448.

30820 (BNWL-23) IRRADIATION EFFECTS ON HIGH-TEMPERATURE REACTOR STRUCTURAL METALS. T. T. Claudson and H. J. Pessl (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1965. Contract AT(45-1)-1830. 23p. Dep.; $1.00(cy), 1(mn) CFSTI.

The effects of irradiation and environment on several new structural metals whose properties are suitable for reactor applications are being determined. Mechanical properties and microstructure of selected alloys are studied. Alloys include solution and precipitation hardenable nickel-base alloys as well as several refractory metal alloys. Two phases of investigation are being followed. First, specimens are being irradiated in three temperature ranges to exposure levels between 5×19^{19} and 1×10^{21} nvt (E > 1 Mev). Iron- and nickel-base alloys are being irradiated at 50, 280, and 650°C. Refractory metal alloys have been irradiated at 50°C. Second, the corrosion and oxidation resistance of each alloy is being studied in environments of 650°C deoxygenated steam and in 815 and 1040°C helium containing 15 mm Hg water vapor. Room-temperature tensile data from specimens of iron- and nickel-base alloys indicate that there may be an aging effect on both the solution and precipitation hardening alloys which is greater than the irradiation effect for low exposures. At higher exposures, the characteristic increase in strength properties prevail. Tensile tests at 700°C on specimens irradiated at 650°C show a marked decrease in ductility and strength with increasing exposure. Irradiation data for the refractory alloys tested at room temperature indicate a rapid deterioration of the ductility of specimens which were in the cold or warm worked condition. Oxidation and corrosion data for the iron- and nickel-base alloys show that generally there is an intergranular attack in alloys showing a large weight gain. Alloys showing a small weight gain under identical conditions exhibit a tightly adherent oxide film that protects the alloy from rapid attack. There is some evidence that environmental pressure plays an important part in the corrosion and oxidation rate of the alloys. For refractory metal alloys, extremely rapid corrosion rates have been observed even in 50°C water during irradiation. (auth)

30821 (BNWL-42) POSTIRRADIATION EVALUATION OF ZIRCALOY PRESSURE TUBES FROM KER-1 AND KER-2. R. C. Aungst (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1965. Contract AT(45-1)-1830. 17p. Dep.; $1.00(cy), 1(mn) CFSTI.

Two Zircaloy-2 pressure tubes representing different fabrication processes were subjected to postirradiation examination after significant exposure in a production reactor. The tubes were discharged from KER loops 1 and 2 in July 1963. One was fabricated by cold drawing to 30% reduction in area and the other by tube reducing to 50% reduction. Neither was autoclaved prior to exposure, but both developed thin, tenacious, abrasion resistant, oxide films. No increase in hydrogen content resulted from the oxidation. The microstructure of tube reduced material showed a marked agglomeration of second phase particles that becomes more severe as radiation dosage increases. This effect was not noted in the drawn tubing. There is no evidence of recrystallization or grain growth in either tube as a result of exposure. In high temperature (300°C) burst tests, both types of tubes showed a greater percentage strength improvement from irradiation than at room temperature. The high temperature ductility of the drawn material is maintained during irradiation to a greater degree than that of the tube reduced material. Initial stress rupture tests on the drawn tubing showed a 5% improvement in rupture strength for the degree of irradiation achieved (unknown nvt). Secondary creep rate was also improved. Slot type brittle fracture tests showed no reduction in resistance to crack propagation at this level of irradiation. (auth)

30822 (BNWL-44) THE EFFECT OF NEUTRON IRRADIATION ON SLIPLINES IN MOLYBDENUM. J. L. Brimhall (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1965. Contract AT(45-1)-1830. 17p. Dep.; $1.00(cy), 1(mn) CFSTI.

Slip line formation during bending was studied on neutron irradiated molybdenum single crystals. For equivalent strains, the slip lines are coarse and distinct in the irradiated molybdenum and not resolvable in the unirradiated molybdenum. Defect-free channels form in the irradiated material during deformation and the slip lines have been directly correlated with these dislocation channels. The heterogeneous distribution of the dislocations during deformation in the irradiated material results from dislocation interaction with the defects produced during irradiation. Impurities, in the form of carbides, affect the dislocation channeling by acting as dislocation sources. (auth)

30823 (GEMP-356) CASCADE AND CLUSTER — COMPUTER PROGRAMS TO SIMULATE RADIATION

DAMAGE PROCESSES IN METALS AND ANALYZE THE DISTRIBUTION OF DEFECTS. D. G. Besco and N. R. Baumgardt (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Apr. 1965. Contract AT(40-1)-2847. 52p. Dep.; $3.00(cy), 2(mn) CFSTI.

CASCADE is a program to describe the dynamics of displacement cascades in the kev energy range in BeO and in metals. CLUSTER describes the resulting distribution of point defects and defect clusters. These programs were combined and instructions are given for use of the combined CASCADE-CLUSTER program. (W.L.G.)

30824 (HW-SA-3629) ELASTOMERS FOR USE IN RADIATION FIELDS. XVII. EFFECT OF GAMMA RADIATION ON MISCELLANEOUS NITRILE ELASTOMERS. Robert Harrington (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). May 15, 1964. Contract AT(45-1)-1350. 21p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Data and discussion are presented showing in general how various nitrile elastomeric compounds are affected by exposure to gamma radiation at several doses ranging up to 1×10^9 R. Some discussion is also presented on the role of the compounding ingredients. (auth)

30825 (ORNL-3789(p.36-55)) RADIATION CHEMISTRY OF THE MOLTEN-SALT REACTOR SYSTEM. (Oak Ridge National Lab., Tenn.).

A series of in-pile tests of the compatibility of Molten-Salt Reactor materials was completed. The MSRE components appear to be compatible for use under the planned conditions of temperature and power density. A prototype in-pile capsule experiment was designed to obtain further information on the effects of irradiation on fuel salts for molten-salt reactors. Fluorine release from solid inorganic fluorides under electron irradiation was studied. Simulated MSRE fuel, Li_2BeF_4, and Li_6BeZrF_{12} were studied. No F_2 was released from Li_6BeZrF_{12}, but the other two materials produced F_2 on irradiation. The G_{F_2} values for both salts passed through maximum values with increasing irradiation time; values for annealed MSRE fuel salt were about half those of the directly frozen salt; values for the Li_2BeF_4 were still lower. A model is proposed for radiolysis of MSRE fuel salt at temperatures below 110°C. A Be-window x-ray tube, coupled closely to a Be-window cell, permitted x-ray doses of 10^{21} ev/hr to a 10-g sample of test salt (simulated MSRE fuel). The yield of F_2 was found to increase with the length of the irradiation period, up to 90 hr, while the yield of O_2 decreased; the total equivalent G value was constant at around 0.09 molecule per 100 ev of energy absorbed. The G value for equivalent F_2 from the irradiation of ThF_4 was raised from 0.005 to 0.014 following treatment with 100% F_2 at 350°C to remove impurities. (J.R.D.)

30826 (ORNL-3789(p.208-22)) IRRADIATION BEHAVIOR OF HIGH-TEMPERATURE FUEL MATERIALS. Oscar Sisman and J. G. Morgan (Oak Ridge National Lab., Tenn.).

Effect of U burnup on release rate of five fission-gas isotopes from fuel particles with laminar, duplex, and triplex pyrocarbon coatings was determined during irradiation of the particles to 1400°C. Fission-gas retention of both the duplex and triplex coatings was shown to be sufficient (at least to 16% burnup) for present reactor applications. Gamma scanning of irradiated fuel spheres can show fuel loading patterns and abnormalities in fuel distribution and can give relative U burnup values. Irradiation has no detectable effect on compression or impact resistance of 1½-in.-dia spheres, but compression resistance of 2.36.-in.-dia spheres may be reduced by irradiation. Metallographic examinations indicate less damage to triplex coatings of the fuel particles than to duplex or laminar coatings. Three metal-clad fuel elements, of ten that have been examined, had suffered cladding failures during irradiation. One failure was caused by a combination of nitride embrittlement of the cladding and overheating of the fuel, and the other two were caused by fuel element distortion and loss of sufficient cooling at local areas. (J.R.D.)

30827 (ORNL-3789(p.223-9)) FISSION-GAS RELEASE DURING FISSIONING OF UO_2. R. M. Carroll, Oscar Sisman, T. W. Fulton, R. B. Perez, and Kiyoshi Inoue (Oak Ridge National Lab., Tenn.).

The defect-trap model previously described for release of fission gases from UO_2 was refined, and an equation was developed which qualitatively reconciles the experimental observations. The irradiation facility was modified to allow neutron flux or temperature to be maintained at a constant value while the other is cycled sinusoidally. An experiment with fine-grain UO_2 demonstrated that grain boundaries do not act as paths of rapid escape but as traps which anchor migrating fission gas. This experiment also verified the effect of fission rate and temperature on fission-gas release as predicted by the defect-trap model. (J.R.D.)

30828 (ORNL-3789(p.230-8)) BEHAVIOR OF CERAMIC MATERIALS UNDER IRRADIATION. (Oak Ridge National Lab., Tenn.).

The annealing of radiation-induced changes was studied by x-ray diffraction for the silicates cordierite, zircon, steatite, and forsterite. Five different irradiation doses were used; annealing was studied at temperatures to 1250°C. The threshold temperature for stored-energy release is compared with the temperature that initiates restoration of x-ray-diffraction lines. Phase transformations are identified. A fluxmeter method for thermal conductivity measurements was developed for use in studies of the annealing of radiation effects. Irradiation of BeO compacts and crystals was carried to dosages of nearly 10^{22} neutrons (of energy >1 Mev)/cm^2; similar experiments with MgO and other oxides are in progress, and a study of radiation stability of refractory carbides was initiated. Gross damage to BeO results primarily from the breaking of grain boundaries by the radiation-induced anisotropic expansion of the crystal lattice; this damage increases with neutron dosage and decreases with increasing irradiation temperature. MgO cannot fail by this mechanism, however it shows damage spread randomly among samples receiving more than 7×20^{20} neutrons/cm^2, increasing with increasing temperature. Expansion of MgO compacts saturates at 1% on exposure to 10^{21} neutrons/cm^2 at 150°C, and is very slight at 800°C and above. The gross damage, which increases with temperature at high temperatures, is probably due primarily to thermal stresses. (auth)

30829 (TID-7697(Add.)) HANFORD IRRADIATION CAPSULES FOR IN-REACTOR CREEP MEASUREMENTS AND URANIUM SWELLING STUDIED. J. A. Williams and R. D. Leggett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. Contract AT(45-1)-1350. 20p. Dep.; $1.00(cy), 1(mn) CFSTI.

A capsule that measures creep of structural materials during irradiation under controlled conditions of constant temperature and uniaxial stress is described, along with its performance characteristics. The design of a constant-temperature irradiation capsule for studying the radio-induced swelling of uranium is also discussed. (T.F.H.)

30830 THE RELATION BETWEEN THE TEXTURE AND RADIATIVE GROWTH OF URANIUM RODS. V. E. Ivanov, V. F. Zelenskii, V. V. Kunchenko, N. M. Raenko, A. I. Stukalov, M. A. Vorab'ev, and A. V. Azarenko. At. Energ. (USSR), 18: 357-60(Apr. 1965). (In Russian)

Results are given of radiation tests carried out with β-heat-treated uranium rods at 200 to 300, 450 to 470, and 480°C. Graphs were constructed for the radiative expansion coefficient G_i as function of the expansion under GI, characterizing the texture of the tested specimens. The elongation component resulting from radiative growth was determined. The coefficient of radiative growth as a function of the temperature was found. It was indicated that the mean value of the linear thermal expansion coefficient α, measured in one direction, was not sufficient for describing the texture of the material unless the texture was uniaxial. A relatively small elongation was observed at 460 to 480°C; a load of 0.25 kg/mm^2 along the axis of the specimen only slightly increased the elongation at 470°C. (R.V.J.)

30831 EFFECT OF HIGH-FLUX FAST-NEUTRON IRRADIATION ON THE PHYSICAL PROPERTIES OF GRAPHITE. H. Bridge, B. T. Kelly, and P. T. Nettley (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Carbon, 2: 83-93(Aug. 1964). (TRG-Report-567)

The changes in the physical properties of British reactor grade graphite induced by high-flux fast-neutron irradiation, under closely controlled conditions of temperature and flux, were studied to higher doses than those previously published. Radioinduced changes in thermal conductivity, thermal expansion coefficients, Young's modulus, electrical resistivity, and dimensions were observed for irradiation doses of up to 3×10^{21} n cm^{-2}, as measured by the reaction $^{58}Ni(n,p)^{58}Co$, at irradiation temperatures in the range 225 to 650°C. The results were considered in terms of the most recent theories of irradiation damage in graphite. It was shown that the observed dimensional changes can be entirely accounted for by crystallite growth in the c-axis direction and shrinkage in the a-axis direction. Some preliminary data on the changes in dimensions and coefficients of thermal expansion in highly oriented pyrolytic graphite are also described and these are shown to be in reasonable agreement with the crystallite changes calculated from the observed behavior of the polycrystalline reactor grade material. (auth)

30832 MATERIAL PROBLEMS IN SATELLITE TECHNOLOGY. Dieter Drechsel (W. C. Heraeus GmbH, Hanau, Ger.). Chem.-Ingr.-Tech., 37: 138-43(Feb. 1965). (In German)

A review is given of the extreme environmental conditions that a spacecraft encounters in its orbit outside the earth's atmosphere. In the simulation of these conditions and the selection of construction materials there are numerous problems. An indication is given of their magnitude. (J.S.R.)

30833 REACTIVITY OF GRAPHITE WITH X IRRADIATED HUMID HELIUM. G. Bombara and V. Mormino (SNAM, Milan). Energia Nucl. (Milan), 12: 319-25(June 1965).

The maximum rate of the possible mass-transfer induced in the C/He, H_2O system by x irradiation was calculated by using known data on the radiolytic water-vapor radicalization, in the following assumptions: energy absorbed only directly by reagents; and energy transmitted also by helium. If extrapolation to the energetic conditions is made in a typical helium-cooled reactor, the first assumption should give place to loss rates superior to the maximum usually tolerable rate in a reactor, while in the second assumption, the same rate of losses should occur. On the other hand results in laboratory experiences carried out up to 500°C have shown that the second assumption can be considered excessive and unlikely and that in a reactor losses could occur at the most in the same rate as the tolerable one. (auth)

30834 OBSERVATIONS OF NEUTRON DAMAGE IN BeO SINGLE CRYSTALS. Robert C. Rau, S. F. Bartram, and K. Lacefield (General Electric Co., Cincinnati). J. Am. Ceram. Soc., 48: 233-5(May 1965).

Observations of neutron damage were made on BeO single crystals irradiated at pile ambient temperature. The crystals darkened during irradiation and often exhibited cracking parallel to the basal plane. Irradiation produced many small defect clusters in the crystals and caused a significant increase in their hardness. X ray diffraction photographs of irradiated crystals showed duplex reflections and continuous streaking between certain spots. (auth)

30835 DISTRIBUTION OF FISSION PRODUCTS IN IRRADIATED UO_2. Noboru Oi (Tokyo Shibaura Electric Co. Ltd.) and Jinzaburo Takagi. J. Nucl. Sci. Technol. (Tokyo), 2: 127-31(Apr. 1965).

Inhomogeneities of fission products and plutonium distribution in irradiated UO_2 were examined. UO_2 pellets were ground so as to let them fracture along the grain boundaries, and the fragments were then dissolved successively into several fractions. The specific activities of these fractions were compared, and the distribution of fission products in the grain and grain boundaries were studied. It was found that at lower temperatures of irradiation (~1400°C), the fission products, except Cs, were distributed fairly uniformly over the grain, while Cs had accumulated at the grain boundaries. At higher temperatures (near or above the melting point of UO_2), inhomogeneity was noticed in the Zr–Nb and Cs distribution. The concentration of these elements varied more along the temperature gradient of the fuel rod than within the grains. Zr-Nb was found to be concentrated in the higher temperature areas of the fuel rod, while conversely, the concentration of Cs was smaller in the same areas. The distribution of Ce, Ru and Pu was found to be fairly uniform throughout the grains. The process of fission product migration in UO_2 is also discussed. (auth)

30836 GAMMA-IRRADIATION OF HIGH-PURITY P-TYPE SILICON WITH SPECIAL REFERENCE TO SINGLE VACANCY. Keiji Matsui and Ryukiti R. Hasiguti (Tokyo Univ.). J. Phys. Soc. Japan, 20: 487-90(Apr. 1965).

The behavior and properties of a defect introduced into high-purity p-type silicon by γ-irradiation at 82°K, which is considered to be a single vacancy, were investigated by means of Hall coefficient and resistivity measurements. It anneals out between about 150° and 220°K. This defect shows a character of net acceptors, of which the predominant energy is located at about 0.2 ev above the valence band. This means that the 5-electron model of a single vacancy should be adopted. Some experimental results pertinent to divacancies in p-type silicon were also obtained. (auth)

30837 DIMENSIONAL CHANGES AND RADIATION CREEP IN GRAPHITE AT VERY HIGH NEUTRON DOSES. J. H. W. Simmons and A. J. Perks (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 206: 610-11(May 8, 1965).

Graphite samples were irradiated in the Dounreay Fast Reactor under stress and creep strains of several percent. The elastic strain at breaking in tension was ~0.1%. Of 20 samples irradiated under stress, two were broken and two were found to have cracks at the junction of the flange and the body of the specimen. The results indicate that the ultimate ductility in tension is certainly >1.5% and may possibly be >2.64%. (P.C.H.)

30838 FOCUSING COLLISION CHAINS IN FACE-CENTERED CRYSTALS AND THEIR IMPORTANCE IN VARIOUS IRRADIATION EFFECTS. G. Duesing and G. Leibfried (Technische Hochschule, Aachen). Phys. Status Solidi, 9: 463-84(1965). (In German)

Focusing collision chains along ⟨110⟩ in fcc crystals are treated for a Born-Mayer type of interaction potential. In an approximation much better than the hard core approximation the energy and the collision angle in the course of a collision sequence and the range of the focusons are calculated. By determining the threshold energy for interstitial transport, the range of replacement collision chains is determined. The number of collision chains produced by a primary atom is estimated and herewith some effects based on collision chains are investigated: energy transport out of defect cascades, production of interstitials outside the cascades, production of defects at dislocations and sputtering. Numerical examples are given for Cu. (auth)

30839 ATOMIC DISPLACEMENT CROSS SECTIONS IN COPPER FOR ANISOTROPIC THRESHOLD ENERGY. H. Wollenberger and J. Wurm (Kernforschungsanlage, Julich, Ger. and Technische Hochschule, Aachen). Phys. Status Solidi, 9: 601-9(1965).

Earlier theoretical investigations on models of α-iron and copper give a highly anisotropic displacement threshold energy, especially near the main crystal axes. Total cross sections for atomic displacements by low energy electrons (E < 0.5 Mev) are calculated with respect to various anisotropic threshold energies. In general, a minimum of the threshold energy near a crystal axis leads to subthreshold events, as found experimentally by Bauer and Sosin. The cross sections derived from experimental measurements have to be corrected to take account of the

effect of the energy loss and the multiple scattering of the electrons before they may be compared with calculated values. The correction method is described and the values from the Bauer and Sosin experiment are given. By fitting the experimental data, the angular-dependent threshold energy is calculated near the ⟨110⟩-direction in copper assuming the residual resistivity increase to be 2.5 μ cm/at. % Frenkel pairs. The threshold energy minimum obtained by this method should be important as regards the production of correlated replacement collisions. (auth)

30840 ENHANCEMENT OF DIFFUSION DUE TO IRRADIATION. W. Schuele (EURATOM, Ispra, Italy). Z. Naturforsch., 20a: 527-32(Apr. 1965).

It is shown that in α-copper-aluminium alloys interstitials are able to change sites with the copper and aluminium atoms by diffusion. The activation energy for migration of interstitials could be determined to be 0.82 ev. In a well annealed specimen the interstitials and vacancies annihilate nearly exclusively by pair recombination. The production rate of free interstitials was found to be slightly larger than that of free vacancies during an irradiation with fast neutrons. The excess interstitials, which are supposed to originate from depleted zones, form clusters acting as sinks, at which essentially interstitials anneal out. Due to these sinks another steady state equilibrium (fixed vacancy case) among point defects and sinks is achieved by repeated irradiations. (auth)

30841 ACTIUNEA RADIATIILOR NUCLEARE ASUPRA CORPULUI SOLID. (Effects of Nuclear Radiation on Solids). Cornelia Motoc. [Bucharest], Editura Academiei Republicii Populare Romine, 1964. 194p.

The after-effects of the exposure of solids to neutron, deuteron, α particle, x, and γ radiations are reviewed. The broad scope of the subject matter allows only a cursory treatment. Information is included on: theory of radio-induced defects, including consideration of displacements, energy threshold, collisions, and energy loss problems; mobility and disappearance of defects; effect of radiation on the physical properties of irradiated solids, such as metals and ionic and covalent crystals; effect of radiation on nuclear fuels, specifically U and its alloys; and radio-induced effects in the corrosion of exposed materials, of interest in reactor design. (420 references). (TTT)

METEOROLOGY

See also GEOLOGY AND MINERALOGY — Site Survey and Selection.

30842 (MIT-2241-3) A REVIEW OF STUDIES OF EDDY FLUXES IN THE STRATOSPHERE AND MESOSPHERE. Report No. 12. Reginald E. Newell (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). Jan. 14, 1965. Contract AT(30-1)-2241. 71p. (CONF-650309-1). Dep.(mn); $3.00(cy), 2(mn) CFSTI.

From Meteorological Problems in the Stratosphere and Mesosphere, Paris.

Equations are developed for atmospheric transport processes, which consist of three components—transport by mean motions, transport by standing eddies arising from the spatial correlation of the transported quantity and the wind velocity, and transport by transient eddies arising from the time correlation. Studies are reviewed on eddy fluxes in the lower stratosphere, long-period variations in the circulation of the lower stratosphere, eddy fluxes from meteorological rocket network data, and energetics of the stratosphere and mesosphere; consideration is given primarily to momentum and heat fluxes. (M.J.T.)

PHYSICS

General

Refer also to abstracts 31336 and 31342.

30843 (AD-608860) AN EXACT ANALYSIS OF LAMINAR MAGNETOHYDRODYNAMIC FLOW IN THE ENTRANCE REGION OF A FLAT DUCT. R. Manohar (Mathematics Research Center, Univ. of Wisconsin, Madison). Sept. 1964. Contract DA-11-022-ORD-2059. 26p. (MRC-TSR-509). $2.00(CFSTI).

A numerical method for obtaining solutions of laminar boundary layer equations for incompressible fluids due to Hartree was modified to obtain solutions of the problem of laminar flow of a conducting fluid with constant properties in the entrance region of a semi-infinite flat duct with a transverse magnetic field. The non-linear equations governing the flow in the entrance region are solved numerically for various values of Hartmann numbers and the corresponding velocity profiles, pressure distribution, and inlet length are obtained. The same method can be applied to other problems of similar nature. (auth)

30844 (ARL-65-53) CHARACTERISTICS OF METAL VAPORS. A. E. Wechsler, P. E. Glaser, and J. Jasperse (Little (Arthur D.) Inc., Cambridge, Mass.). Oct. 1964. Contract AF33(657)-11735. 54p. CFSTI.

The objective of this experimental and analytical study is to determine the effects of metal vapors on the radiation heat transfer characteristics of arc and plasma systems. A high temperature absorption cell suitable for transmission measurements of alkali metal vapors at temperatures of 300 to 750°C with vapor path lengths of 4 to 8 inches is described. The results of calibration tests using the absorption cell and an optical system capable of resolution of 1 to 8 Å over the spectral region from 2000 to 9000 Å are presented. Typical data on the transmission of sodium vapor are given, and methods of data reduction to obtain spectral absorption coefficients are proposed. A preliminary discussion of the radiation characteristics of vaporized electrode components such as tungsten, copper, and graphite is given. (auth)

30845 (RPI-328-35) LINEAR ACCELERATOR PROJECT. Progress Report, January–March 1965. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. 149p. Dep.(mn); $4.00(cy), 3(mn) CFSTI.

A total of 15 papers and brief summaries are included. They treat neutron spectra, scattering, and reactions in such materials as D_2O, Be, H_2O, polyethylene, and W isotopes. Some radiation effects work is also reported. Separate abstracts are presented for four of the papers. For abstracts of three other papers, see NSA 19: 25457, 25458, and 29177. (D.L.C.)

For abstracts of individual papers see: 31196, 31197, 31233, and 31234.

30846 (UCRL-7907) CORRESPONDING STATES AT SMALL INTERATOMIC DISTANCES. R. Norris Keeler, Marvin Ross, Mathias Van Thiel, and Berni J. Alder (Lawrence Radiation Lab., Univ. of California, Livermore). June 26, 1964. Contract W-7405-eng-48. 8p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

By measuring the thermodynamic properties of condensed rare gases to pressures of about half a million atmospheres, it was established within 2% accuracy that argon and xenon obey the rule of corresponding states under extreme conditions of pressure and temperature. At pressures of 200,000 atmospheres and higher, strong deviations from corresponding states become apparent in xenon, which can be traced to large-scale thermal excitation of electrons into the conduction band. (auth)

30847 (UCRL-12473) PHYSICS DEPARTMENT PROGRESS REPORT, OCTOBER 1964–JANUARY 1965. A. Lorenz, ed. (Lawrence Radiation Lab., Univ. of California, Livermore). Contract W-7405-eng-48. 91p. Dep.; $3.00(cy), 2(mn) CFSTI.

Five sections are included; a separate abstract has been prepared for each. (T.F.H.)

For abstracts of individual sections see: 30848, 30849, 31136, 31241, and 31336.

30848 (UCRL-12473(p.31-63)) THERMODYNAMIC PROPERTIES OF MATTER. (Lawrence Radiation Lab., Univ. of California, Livermore).

Research review includes: Monte Carlo and molecular-dynamics calculations of pair distribution functions of a classical electron gas; thermodynamics of interacting Bose systems; improvements in virial expansions at low densities; Thomas-Fermi equations of state for matter at high temperatures and pressures; Fortran program EOSCHK for comparing and evaluating equations of state in given pressure and density regions; hydrogen pair potentials at high densities; one-dimensional model of shock-induced phase transformations in matter; design and characteristics of a flash light source utilizing high-explosive implosion-heating of the Ar light source; phase transformations in KCl, KBr, NaCl, and Bi under shock-wave pressure loading; demagnetization of nickel ferrite under shock compression and heating; and the dynamic equation of state of NaCl. (T.F.H.)

30849 (UCRL-12473(p.80-6)) MATHEMATICAL AND COMPUTATIONAL METHODS. (Lawrence Radiation Lab., Univ. of California, Livermore).

VORTEX is a two-dimensional hydrodynamics calculation of incompressible flow, which calculates the positions and velocity of up to 300 point vortices. VORTEX is written for the LARC computer. The output is in the form of either a motion picture strip or trajectories of a given point. (T.F.H.)

30850 (UCRL-13152) ELECTRICAL AND EMISSIVE PROPERTIES OF EXPLODED CONFINED CONDUCTORS. Charles P. Nash, Robert P. DeSieno (California Univ., Davis), and Clifford W. Olsen (Lawrence Radiation Lab., Univ. of California, Livermore). [1962]. Contract W-7405-eng-48. 26p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The explosion in air of internally silvered Pyrex or quartz tubes is characterized by a (virtually) exponential decay of the condenser voltage with time, whereas the restrike phase of an unconfined exploding wire is oscillatory. The luminosity of these tubes is nearly time independent. The emission spectra of silvered tubes show only an intense continuum apart from a very few reversals. When wires threaded axially within Pyrex or quartz tubes are exploded in air, a "leaky" pause is observed, the duration of which varies with the tube diameter. The restrike portion of the oscillograms for wires exploded in tubes is nearly always non-oscillatory. The spectra of wires exploded in 1 mm tubes (long pause) show mostly line emission with only a faint continuum. The spectra of wires exploded in 8 mm tubes (abnormally short pause) show essentially a pure continuum, with a few reversals. Photographs of these latter samples show that restrike occurs between the tube wall and the wire vapor perimeter. It is suggested that a major contributor to the continuum is an interaction between the discharge and the tube wall for either axial wires or silvered tubes. (auth)

30851 (JPRS-29270) TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 163. [1963]. 125p. (TT-65-30581). $4.00(CFSTI).

For an abstract of the individual paper see: 31246.

30852 GEOMETRICAL WAVE AND QUANTUM OPTICS. Nicholas Chako (City Univ. of New York). Acta Phys. Polon., 27: 157-78(Feb. 1965).

An attempt is made to show mathematically the connection of geometrical optics on one hand and wave optics and

light quanta on the other. The close relation of the different aspects of light are established through the intermediary equations, better known as transport equations. These equations are satisfied by the so-called amplitudes of various orders of the full asymptotic solution of the wave equation in terms of the wave parameter (wave length) on one hand and the equations of variations for the rays on the other hand. The transport equations are discussed in detail for a very general partial differential equation of the wave type including their relation with the equations of variations of different orders which result from the application of perturbation theory to classical dynamical systems or the corresponding ray or geometrical optics equations. This mathematical relation reveals the asymptotic character of the ray or particles aspect of the wave concept of light or dynamics described by the Schrödinger or Dirac equations. Furthermore, the introduction of light quanta or photon concept in the description of some optical experiments by the usual procedures of quantizing the electromagnetic field has opened a new field, which for a lack of a better name, is called quantum optics, that ultimately may give the true or correct description of many optical phenomena, which at the present time are beyond the scope of classical electrodynamic theory. It is pointed out that the recent investigations are based on the geometrical wave solution of the equations, that is to say of the wave packet expression for the photons, which correspond to the leading term of the asymptotic solution by neglecting the terms which account for the spreading of packet as it propagates through the medium. (auth)

30853 STATISTICAL-MECHANICAL THEORY OF INCOHERENT VAN HOVE'S SCATTERING FUNCTION FOR THERMODYNAMIC SYSTEMS. Andrzej Fulinski (Jagellonian Univ., Krakow). Acta Phys. Polon., 27: 245-58 (Feb. 1965).

Using the so-called second quantization formalism, the incoherent scattering function $S_{inc}(Q,\omega)$ is found to be related (in some energy range) in a simple way with the average occupation numbers $\langle N(p)\rangle$ distributions for nonideal systems of interacting particles. This gives the possibility of determination of $\langle N(p)\rangle$ from incoherent scattering experiment, especially, from slow neutron scattering by thermodynamic systems, and, on the other hand, permits to calculate the scattering function using the temperature-dependent perturbation theory. It is found that the coherent part of scattering tends towards zero for ideal Boltzmann systems. It is, however, no longer valid for ideal quantum systems. The perturbational corrections are given for Boltzmann systems, and it is found that the interaction between the particles of the scattering system can cause the decrease of the cross section. The perturbational corrections depend on the proper form of the potential of interaction between particles of the scatterer. (auth)

30854 MICROSCOPIC FOUNDATION OF RELATIVISTIC HYDRODYNAMICS. N. A. Chernikow (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Physiol. Polon., 27: 465-89(Mar. 1965).

Relativistic hydrodynamic equations for dissipative processes are derived from the relativistic transport equation. The problem is solved by the method of moments. In order to extend the method of moments to the relativistic case a relativistic generalization of the Hermite-Chebyshev polynomials is introduced. The viscosity and heat conductivity coefficients are expressed in terms of definite integrals of the differential cross section for the gas particle interaction. The calculation fits in well both the non-relativistic and ultra-relativistic limiting transition. (auth)

30855 ONE DIMENSIONAL RANDOM WALK WITH A PARTIALLY REFLECTING BARRIER. G. Lehner (Euratom-CNEN, Italy). Ann. Math. Statist., 34: 405-12(June 1963). (RT/FI(65-2)

The one-dimensional random walk of a particle restricted by a partially reflecting barrier is considered. The reflecting barrier is described by a coefficient of reflection r. The probability of finding a particle at a lattice point m after N steps is calculated and expressed in terms of hypergeometric functions of the ${}_2F_1$-type. Other theorems are deduced concerning the one-dimensional random walk. For instance, the number of paths leading from one lattice point to another lattice point in N steps and showing a given number of reflections at the barrier is calculated. (auth)

30856 VORTEX LINES AND THE λ-TRANSITION. Eero Byckling (NORDITA, Copenhagen). Ann. Phys. (N. Y.), 32: 367-76(May 1965).

The vortex-line contribution to the specific heat of liquid He II is expressed in terms of a lattice line model. A connection between the partition function of the model and that of the Ising lattice is found and is used to calculate properties of the model. The system has a phase transition at which the concentration of lines and their average length increase suddenly, and c_v has a logarithmic singularity. The possible connection with the λ-transition is discussed. (auth)

30857 SPIN-PHONON INTERACTIONS IN A HEISENBERG FERROMAGNET. Erling Pytte (Harvard Univ., Cambridge, Mass. and Univ. of California, Berkeley). Ann. Phys. (N. Y.), 32: 377-403(May 1965).

The effect of an interaction Hamiltonian linear in the phonon field and quadratic in the spin operators on a system of noninteracting spin waves and phonons for an ideal Heisenberg ferromagnet is studied by using the techniques of quantum field theory. Assuming the coupling to be weak, a perturbation expansion is performed, and the renormalized spin wave and phonon energies are calculated to lowest order, together with the lifetimes of the individual excitation modes. The calculations are performed separately for two different approximations for the spin system. The random phase approximation (RPA) is used to study the behavior of the system near the Curie temperature, and the Holstein-Primakoff approximation is used at low temperatures. The interaction leads to a shift in the Curie temperature, T_c, but the behavior of the magnetization, σ, (calculated in RPA) in the neighborhood of the Curie temperature is virtually unchanged. At low temperatures, in addition to a renormalization of the coefficient of the Bloch $T^{\frac{3}{2}}$ term (3), a T^4 term is obtained in the magnetization which is entirely due to the interaction. The sound velocity is renormalized by the interaction; the change in the sound velocity vanishes at $T = 0$ and also for $T = T_c$ in the absence of an external magnetic field. In the neighborhood of the Curie temperature, the phonon spectrum is found to have a term linear in σ. Because $d\sigma/dT$ is large (∞ in RPA) at T_c the phonon contribution to thermodynamic quantities involving $(d\omega/dT)(q,T)$ like the specific heat, will be peaked at the Curie point. Finally, an expression for the thermal expansion coefficient of the lattice is derived which, in addition to the usual term proportional to the phonon contribution to the specific heat, is found to have a term proportional to the specific heat of the spin system. Therefore, the thermal expansion coefficient will have a discontinuity at T_c, as expected in a phase transition of the second kind. At low temperatures it is proportional to $T^{\frac{3}{2}}$, the spin contribution again being dominant. (auth)

30858 THE MEAN FREE PATH IN THE RECOMBINATION OF AIR IONS. Siksna, Reinhards (Uppsala Univ.). Arkiv Geofysik., 4: 473-501(1965).

Formulas for the recombination coefficients of ions involving the mean free path of the ions are reviewed, and general formulas for the combination and recombination coefficients of aerosol particles are given. Definitions and formulas for the mean free path and apparent mean free path are then considered; and the derivation of formulas for the mean free path of charged particles or ions, with consideration of the relation between the mean free path and the collision cross section, is outlined. The selection of appropriate numerical values of the diffusion coefficient, mobility, and mean thermal velocity for the evaluation of the formulas for the mean free path is then considered. (D.C.W.)

30859 PARAMETRIC AMPLIFIER WITH TRANSVERSE INTERACTION AND ELECTROSTATIC ELECTRON BEAM FOCUSING. V. I. Yur'ev. Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 153-61(1965). (In Russian)

The general possibility is pointed out of constructing a parametric amplifier with transverse interaction and electrostatic focusing of the electron beam. Systems suggested previously are used as the signal-beam coupling element. The amplifier characteristics for some parameters of the system are presented. (auth)

30860 THE INFLUENCE OF CONSTANT ELECTRIC AND MAGNETIC FIELDS UPON THE FORMATION TIME OF ULTRA HIGH-FREQUENCY PULSE DISCHARGE IN GAS. S. M. Levitskii, A. Ya. Yavlinskii, and I. V. Shirokov (Kiev State Univ.). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 162-8(1965). (In Russian)

The influence is investigated of constant electric and magnetic fields upon the time of formation of an ultra high-frequency impulse discharge in air at pressures of 10^{-3} to 10^{-1} mm Hg. It is shown that a constant electric field increases but a constant magnetic field decreases the time of discharge formation near cyclotron resonance). In the presence of both fields the electric field compensates the effect of a constant magnetic field on the time of discharge formation. (auth)

30861 ON THE THEORY OF ELECTRICALLY CONDUCTING FLUIDS BETWEEN TWO PARALLEL AND DAMPED OSCILLATING FLAT PLATES IN THE PRESENCE OF TRANSVERSE MAGNETIC FIELD. Yeong Heum Jyoo. New Phys. (Korea), 3: No. 1, 14-17 (1963). (In Korean)

The distribution of velocity, magnetic field, and related physical quantities such as electric field and current density are obtained under the usual assumption in magnetohydrodynamics for the flow of an incompressible, viscous and electrically conducting fluids between two parallel and damped oscillating infinite flat plates, distance 2η apart, in the presence of transverse magnetic field. General solutions are derived for four cases. (L.B.S.)

30862 STUDY OF AN ION SOURCE OF HIGH INTENSITY AND HIGH EFFICIENCY. J. F. Bonnal, J. Giacomini, G. Mainfray, C. Manus, and J. Morellec (Commissariat a l'Energie Atomique, Gif-sur-Yvette, France). Nucl. Instr. Methods, 34: 328-40(June 1965). (In French)

An electron-bombardment ion source that produces a mercury beam with current intensity over 0.3 amp and has a mass utilization efficiency of about 80 percent is studied. A 10 cm diameter cylindrical source is described which operates with mercury vapor pressure between 10^{-4} and 10^{-3} torr. The magnetic field is about 50 G. A certain particular type of this source can operate without magnetic field. A study of the plasma in the source brought out optimum operating conditions required to obtain high intensity and efficiency beams. (auth)

30863 RELATIVISTIC TRANSFORMATION OF THERMODYNAMICAL QUANTITIES. (BEWARE OF JACOBIANS). A. Gamba (Universita, Genoa). Nuovo Cimento (10), 37: 1792-4(June 16, 1965).

The relativistic transformation of the quantity of heat, dQ, and the temperature is discussed. The source of the error in the original transformation equation is pointed out. An important consequence of the corrected theory with regard to the classical theory of electrons is shown. (C.E.S.)

30864 COLLISIONAL INTEGRALS FOR THE EXPONENTIAL ATTRACTIVE POTENTIAL. R. J. Munn, E. A. Mason, and Francis J. Smith (Univ. of Maryland, College Park). Phys. Fluids, 8: 1103-5(June 1965).

Collision integrals for the exponential attractive potential are calculated by accurate numerical integration. There are some unexpected differences from what had been expected by analogy with inverse power attractive potentials. Some implications of these results for the calculation of high-temperature gas transport properties are discussed. (auth)

30865 SURFACE ELECTROHYDRODYNAMICS WITH HIGH FREQUENCY FIELDS. E. B. Devitt and J. R. Melcher (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 8: 1193-5(June 1965).

When an interface between fluids having different electric properties is stressed by an electric field, field-coupled surface waves result. Experiments in which the imposed fields have a frequency of 50 kc are described. This frequency is high enough to make all free charge effects insignificant and to avoid parametric interactions. An attempt is made to show that in this limit the dynamics of the field-coupled polarization surface waves are just as they would be predicted using rms fields with a theory based on constant fields. Measurements of the conditions for instability with the field perpendicular to the interface and of the resonant frequency shift with the field tangential to the interface are considered. (C.E.S.)

30866 EQUATIONS FOR FINITE CONDUCTIVITY MAGNETOHYDRODYNAMICS. V. A. Rykov. Prikl. Mat. i Mekhan., 29: 178-81(Jan.-Feb. 1965). (In Russian)

Plane, non-stationary flow in a magnetic field perpendicular to the flow plane is described by a set of equations of magnetohydrodynamics. For $\gamma = c_p/c_v = 2$ a conversion is given that depends on a single arbitrary function of time. An exact solution describing the compression of a plasma cylinder of finite conductivity is considered as an example of the transformation. The converted equations are similar in form, but contain an external force in the equations of motion. The solution describes the equilibrium state of a fictitious medium which can be transformed into its original coordinates. The gas density distribution, the hydrodynamic pressure which increases continuously due to Joule heating, and the magnetic field which penetrates within the conducting gas and starts it moving are described in the solution. (TTT)

30867 TRANSPORT, COLLECTIVE MOTION, AND BROWNIAN MOTION. Mori, Hazime (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 33: 423-55(Mar. 1965).

A theory of many-particle systems is developed to formulate transport, collective motion, and Brownian motion from a unified, statistical-mechanical point of view. This is done by, first, rewriting the equation of motion in a generalized form of the Langevin equation in the stochastic theory of Brownian motion and then, either studying the average evolution of a non-equilibrium system or calculating the linear response function to a mechanical perturbation. An expression is obtained for the damping function $\varphi(t)$, the real part of the Laplace transform of which gives the damping constant of collective motion. A general equation of motion for a set of dynamical variables A(t) is derived, which takes the form $\frac{d}{dt}A(t) - i\hat{\omega}\cdot A(t) + \int_0^t \varphi(t-s)\cdot A(s)ds = f(t)$, where $\hat{\omega}$ is a frequency matrix determining the collective oscillation of A(t). The quantity f(t) consists of those terms which are either non-linear in A(s), $t \geq s \geq 0$, or dependent on the other degrees-of-freedom explicitly, and its time-correlation function is connected with the damping function $\varphi(t)$ by $(f(t_1), f(t_2)^*) = \varphi(t_1 - t_2)\cdot(A, A^*)$. An expression is obtained for the linear after-effect function to thermal disturbances such as temperature gradient and strain tensor. Both the conjugate fluxes and the time dependence differ from those of the mechanical response function. The conjugate fluxes are random parts of the fluxes of the state variables, thus depending on temperature. The difference in the time dependence arises from a special property of the time evolution of f(t) and ensures that the damping function and the thermal after-effect function are determined by the microscopic processes in strong contrast to the mechanical response function. The difficulty of the plateau value problem in the previous theories of Brownian motion and transport coefficients is thus removed. The theory is illustrated by dealing with the motion of inhomogeneous magnetization in ferromagnets and the Brownian motion of the collective coordinates of fluids. Explicit expressions are derived for the thermal

after-effect functions and the transport coefficients of multi-component systems. (auth)

30868 TEMPERATURE DEPENDENCE OF SPECTRAL DISTRIBUTION WITH ACTIVATION OF THERMIONIC EMISSION FROM (Ba–Sr) O CATHODES. Kazuo Ishikawa. Sci. Rept. Res. Inst., Tohoku Univ., Ser. A, 16: 235-48 (Dec. 1964).

Temperature dependence over about 750 to 850°K of several peaks on the spectral distribution between 0.6 and 3.5 ev of thermionic emission from (Ba–Sr)O cathodes was observed with activation. Three kinds of the cathodes which were easy or difficult to activate were used as specimens. From the experiment on the three kinds of the cathodes, it was found that there were three stages in the activation process of (Ba–Sr)O cathodes, although total thermionic emission always increased with activation through the whole process. In the activation stage I, with activation, the maximum temperature of the 3.2-ev peak shifted to higher temperature, although the work function decreased and the intensity of each peak increased. In the stage II, with activation, the work function increased on the contrary, the intensity of 3.2-ev peak decreased showing negative effect, and the maximum temperature of the 3.2-ev peak shifted to a lower temperature and then to a higher one. In the stage III, with activation, the work function decreased, the intensity of each peak increased, and the maximum temperature of each peak markedly moved to a lower temperature. From these results, it was clearly known that the earlier two stages were the abnormal stages and only the stage III was the normal activation stage. (auth)

30869 CHARACTERISTIC ENERGY LOSS OF ELECTRONS AND COLOR CENTERS IN NaF. F. Pradal and C. Gout (Universite, Toulouse). Solid State Commun., 2: 331-3(Nov. 1964). (In French)

The energy losses of a beam of electrons of 20 kv passing through thin films of NaF are analyzed. In addition to the characteristic spectrum, two lines that are probably due to the destruction of colored centers are observed. (tr-auth)

30870 MEASUREMENT OF ELECTRON DRIFT VELOCITY IN N_2 IN THE E/P REGION FROM 0.05 TO 40 volt/cm TORR (SPARK CHAMBER METHODS). W. F. v. Fischer-Treuenfeld (Universitat, Hamburg). Z. Physik, 185: 336-44(1965). (In German)

A special spark chamber technique was used to measure drift velocities of electrons for N_2 over an E/p-range from 0.05 to 40 volts/cm·torr. The inaccuracy is smaller than 5% in the medium E/p-range and increases to 10% at the ends of the region. This method uses a single α particle traversing a parallel plate gap. The α particle triggers by a photomultiplier a high voltage pulse which initiates an avalanche discharge. By varying the delay time after which the high voltage pulse is triggered one deduces from the height of the avalanche discharge the time necessary for the electrons to cross the gap and thus the drift velocity. (auth)

30871 STABILITY OF TANGENTIAL DISCONTINUITIES IN MAGNETOHYDRODYNAMICS. V. L. Sizonenko and K. N. Stepanov. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 23-30 (Nov.-Dec. 1964). (In Russian)

The stability of a tangential discontinuity of an ideally conducting compressible fluid in an intense magnetic field is studied when the Alfven velocity on both sides of the surface of discontinuity $V_{a1,2}$ is appreciably higher than the velocity of sound $V_{s1,2}$. It is shown that the tangential discontinuity is unstable if the magnetic field does not change its direction (or changes it by 180°) when passing through the surface of discontinuity and the jump in fluid velocity v is not collinear with the magnetic field. If the velocity v collinear with the magnetic fields acting on each side of the surface is not close to zero, then the tangential discontinuity is stable for $v < v^*$ and unstable for $v > v^*$, where v^* is the order of the Alfven velocity. The boundary of the stable region $v = v^*$ is established for a number of limiting cases. (ATD)

30872 ELEKTROFIZICHESKAYA APPARATURA. SBORNIK STATEI. VYPUSK 2. (Electrophysical Devices. Collection of Articles. Volume 2). E. G. Komar, ed. Moscow, Atomizdat, 1964. 200p.

Experimental and theoretical investigations on high-voltage electric discharge, magnetic field configurations, electron-ion optical systems, electrostatic generators, magnetic field stabilization linear accelerators, and power supplies for accelerators are discussed. Separate abstracts are prepared for 9 of the 22 papers presented. (C.E.S.)

For abstracts of individual papers see: 30899, 30900, 30901, 30902, 30903, 30904, 30905, 31414, and 31415.

30873 GAMMA RAY SCATTERER (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Livermore). 9 drawings. (CAPE-1198)

Drawings (9) are presented for the γ-ray scatterer magnet which consists of a toroidal core wrapped with magnetic tape (Supermendur) in 45 separate bands 120 turns thick. The core consists of two annular rings of Heavymet held together by 5 Inconel clamps. After the tape is wound, it is annealed at ~1000°C in a saturating magnetic field provided by 30 turns of silver wire placed inside the magnet and later removed. The entire magnet is enclosed in a mild steel case, 12 in. dia, 5¼ in. deep, with a ½ in. thick top and bottom, which provides shielding and protection for the magnet. The magnet generates a total flux of ~700,000 lines alternating in the form of a square wave of 200 cps. The magnet was designed for γ-ray circular polarization measurements on the rapidly decaying nuclide ^{24}Al (2.1-sec half life). (D.L.C.)

Accelerators

Refer also to abstract 30565.

30874 (AD-609057) STUDY OF SIMULATION TECHNIQUES FOR LABORATORY SIMULATION OF NUCLEAR RADIATION ENVIRONMENTS. Final Report, December 1, 1963–November 30, 1964. K. G. Kerris (Hughes Aircraft Co., Fullerton, Calif.). Contract Nonr-4359(00). 70p. (FR-64-10-317). $3.00(CFSTI).

The feasibility of a 15-Mev 1000-ampere electron storage ring is demonstrated. The work reported is the continuation of the electron storage ring feasibility study begun under Contract NOnr 3481(00). All the important beam loss mechanisms are treated, including space charge and coherent and incoherent image force effects. The problem of imperfection and coupling resonances is discussed. The analytical work led to the design of a ¼-scale model magnet. The results of magnetic field mapping in this magnet are presented. Finally, a preliminary storage ring design which is considered feasible is discussed. (auth)

30875 (BNL-8905) A HIGH-FIELD MAGNET FOR THE ALTERNATING-GRADIENT SYNCHROTRON. George Parzen (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 8p. (CONF-650306-3). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Particle Accelerator Conference, Washington, D. C.

A discrete excited pole magnet is designed for obtaining the required spatial variation of the magnetic field for alternating-gradient synchrotrons and which may offer the possibility of going to higher magnetic fields. The orbit results and the logarithmic and radial displacement of magnets are discussed. (L.B.S.)

30876 (BNL-8936) RF STRUCTURES FOR LINEAR ACCELERATORS. G. W. Wheeler and S. Giordano (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 17p. (CONF-650306-6). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Particle Accelerator Conference, Washington, D. C.

A brief review is given of the fundamental requirements

for r-f accelerating structures for electron and proton linacs. Descriptions of drift-tube, iris-loaded waveguide, slotted-iris waveguide and cloverleaf structures are presented. Two $\pi/2$ mode structure, H-type and R-type, which are investigated for acceleration of protons to high energies, are discussed. (L.B.S.)

30877 (BNL-9062) MAGNETIC FINGERS. R. B. Palmer (Brookhaven National Lab., Upton, N. Y.). Mar. 1965. Contract AT-30-2-GEN-16. 18p. (CONF-650111-2). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From CERN Informal Neutrino Conference, Geneva.

A distribution assumed for positive pion momenta emitted at various angles in the interactions of 30-Bev protons with Be is presented; the positive kaon flux is assumed to be $1/10$ of the pion flux. These distributions are used to calculate the neutrino spectrum, from the pion and kaon decay, expected using the CERN horn. The CERN horn is compared with an ideal focusing device, which focuses all particles toward the neutrino detector regardless of their angle, momentum, or point of origin. The ratio of the mean particle angles before and after a focusing device is examined as a function of particle momentum, for various focusing configurations. The shape calculated to focus the most popular momentum is illustrated and called a finger current sheet. The neutrino spectrum obtained using a triple combination of magnetic fingers is shown and compared with the ideal spectrum. (M.J.T.)

30878 (BNL-9080) CONSTANT-SPILL SERVO FOR AGS. H. J. Halama and R. L. Cassel (Brookhaven National Lab., Upton, N. Y.). Apr. 1, 1965. Contract [AT(30-2)-Gen-16]. 6p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The block diagram of the constant spill servo is given, and its two closed loops, a fast loop and a high-gain slow-response loop, are described. Plots are shown of the variation of gain and phase with frequency of the magnet power supply with the ripple filter on. Using the slow and fast servo loops, a transfer function to produce a flat spill within 5% can be achieved. (M.J.T.)

30879 (BNL-9090) RF SEPARATION TECHNIQUES AT A SUPER-HIGH-ENERGY ACCELERATOR. [PART] I. J. Sandweiss (Brookhaven National Lab., Upton, N. Y.). Mar. 25, 1965. Contract [AT(30-2)-Gen-16]. 19p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

R-f beam systems for use with a 1000-Bev proton accelerator are studied with particular reference to the limits set by beam transmission and particle yields. Deflector properties, magnetic optics of the intercavity section, and pre- and post-separator optics are considered. The desirability of an r-f frequency higher than 3000 Mc is explicitly demonstrated. Typical beam transmission is estimated for an r-f deflector frequency of 10,000 Mc. Useful K-meson beams to 250 Bev/c and antiproton beams to 350 Bev/c are found to be achievable. (M.J.T.)

30880 (BNL-9091) THE MANY-BODY PROBLEM IN ACCELERATORS DUE TO HIGH BEAM INTENSITY. PART I. QUALITATIVE OUTLINE AND SOME QUANTITATIVE ASPECTS OF THE THEORY. A. M. Sayied (Brookhaven National Lab., Upton, N. Y.). July 24, 1964. Contract [AT(30-2)-Gen-16]. 33p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

It is proposed to calculate the changes in ground state eigenfunction and eigenenergy and dispersion relation for the quasiparticle behavior and collective modes of excitation, viewing the charge-density problem of accelerators as a many-body problem and using the mathematics of quantum field theory. The mechanics of the problem are examined using Liouville's equation for the time derivative of the density function; hamiltonians for several cases are written down and studied. Elementary excitation spectra, including single particle excitations (quasiparticles) and density-fluctuation excitations (quasiparticle excitations and collective mode), are discussed. (M.J.T.)

30881 (BNL-9129) MEDIUM-ENERGY SEPARATED BEAM TO THE 31-IN. BUBBLE CHAMBER. H. N. Brown (Brookhaven National Lab., Upton, N. Y.). Apr. 1, 1965. Contract [AT(30-2)-Gen-16]. 27p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A particle separating transport system to service the 31-in., 20-kG bubble chamber at the AGS is considered. The expected performance characteristics of the beam and the engineering parameters needed to proceed with its detailed design are described. Diagrams are shown of the beam location and component layout. Component functions and optical characteristics are discussed, including target and targeting vacuum chamber, shield pipe, solid-angle collimator, momentum definition, first-stage mass separation, chromatic aberrations, bending magnet aberrations, quadrupole aberrations, second-stage separation, and images and beam envelopes. Estimated particle yields for K^- and $\bar{p}$ beams are presented as functions of momentum. (M.J.T.)

30882 (ORNL-P-1145) AN ACCELERATOR RADIATION PROTECTION SYSTEM. G. F. Wells and W. E. Lingar (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 5p. (CONF-650306-56). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Particle Accelerator Conference, Washington, D. C.

An accelerator radiation protection system is discussed, providing delayed automatic shutdown of the accelerator beginning when a door to a hazardous area is opened; the delay time is inversely proportional to the radiation level in the area. The components of the system are described, including ionization chamber, electrometer amplifier, signal comparator and selector, and preset timer and counter, and operational experience is reviewed. (M.J.T.)

30883 (PPAD-2137-543) THE EXTERNAL PROTON BEAM FOR THE PRINCETON-PENNSYLVANIA ACCELERATOR. J. W. Benoit, K. B. Conner, J. Kirchgessner, and F. C. Shoemaker (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Mar. 10, 1965. Contract AT(30-1)-2137. 12p. (CONF-650306-47). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Particle Accelerator Conference, Washington, D. C.

Various components of the beam-extraction system of the 3-Bev Princeton-Pennsylvania weak-focusing proton synchrotron are in design, construction, and installation phases. The beam-extraction system is a resonant system using the $\nu_r = 2/3$ resonance. This system has the advantages of high efficiency and small emittance, and requires only that the final extraction magnet (septum magnet) be plunged. (T.F.H.)

30884 (RPI-328-24) PRACTICAL OPERATING PROBLEMS AT THE R.P.I. LINAC. R. Krasse, R. Fullwood, and R. Browne (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science). [1962]. Contract AT(30-3)-328. 15p. (CONF-650306-49). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Particle Accelerator Conference, Washington, D. C.

Organization, maintenance, and training problems and procedures are presented as applicable to the R.P.I. Linac. Klystron failures, thyratron replacement, and voltage standing-wave ratio problems are discussed. Solutions to these problems are given. (T.F.H.)

30885 (RPI-328-26) ELECTRONIC INSTRUMENTATION AT THE R.P.I. LINAC. R. R. Fullwood, D. E. Kraus, and W. A. Bryant (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science). [1965]. Contract AT(30-3)-328. 6p. (CONF-650306-48). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Particle Accelerator Conference, Washington, D. C.

The electronic instrumentation used in various types of experiments in the R.P.I Linac is reviewed. Particular attention is devoted to logic, data recording, and pulse analyzing components. (T.F.H.)

30886 (RPI-328-27) QUALITATIVE EFFECTS OF RADIATION DAMAGE ON EQUIPMENT AND COMPONENTS AT THE R.P.I. LINAC. R. R. Fullwood, E. R. Gaerttner, and R. Krasse (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science). [1964]. Contract AT(30-3)-328. 5p. (CONF-650306-50). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Particle Accelerator Conference, Washington, D. C.

Radiation damage in and around neutron-producing targets in the R.P.I. Linac is discussed. Maintenance procedures for alleviating this damage are outlined. (T.F.H.)

30887 (RPI-328-32) LECTURE NOTES ON THE OPERATION OF THE R.P.I. LINAC. R. Fullwood (Rensselaer Polytechnic Inst., Troy, N. Y.). May 11, 1964. Revised Aug. 30, 1964. Contract AT(30-3)-328. 109p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

An operator's manual for the R.P.I. Linac is presented. (T.F.H.)

30888 (SLAC-35) FUNCTIONAL DESCRIPTION OF THE TRIGGER SYSTEM FOR THE STANFORD TWO-MILE ACCELERATOR. J. Faust (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Jan. 1965. Contract AT (04-3)-400. 21p. Dep.; $0.50(cy), 1(mn) CFSTI.

The accelerator subsystems whose switching time is precisely controlled by the trigger system are listed. Diagrams of the trigger systems are given, and a functional description of the major components of the system is presented, including the sequence generator, rate selector, master trigger generator, sector trigger generator, and pattern generator. (M.J.T.)

30889 (UCRL-16020) SUPER-ENERGY ACCELERATORS. Lloyd Smith (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 1965. Contract W-7405-eng-48. 4p. (CONF-650306-62). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Particle Accelerator Conference, Washington, D. C.

Alternating gradient synchrotron design can be extrapolated in a relatively straightforward way to larger circumference and higher particle energy. This means of increasing available energy is more attractive economically than any other accelerating system that has been suggested. Since increased energy makes it possible to uncover new phenomena as well as extend knowledge of effects presently known, a number of groups in the United States and Europe are intensively developing design studies of synchrotrons up to as large as 1000 Bev. A review of the work of these various groups is presented, with particular emphasis on a 200-Bev study at the Lawrence Radiation Laboratory. (auth)

30890 AN EXPERIMENTAL INSTALLATION FOR STUDYING AND TESTING ION SOURCES AND ELECTRON INJECTORS. M. Ianovici and Th. Ionescu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 15: 355-8(1964). (In Rumanian)

An installation designed for the determination of the optimum operating parameters of electron injectors and ion sources is described. (D.C.W.)

30891 COMBINATION OF ELECTRIC AND MAGNETIC FOCUSINGS IN CYCLIC ACCELERATORS. Goro Miyamoto, Giiti Iwata, and Kazuo Huke (Tokyo Univ.). J. Phys. Soc. Japan, 20: 629(Apr. 1965).

The use of combined electric and magnetic fields to improve the beam focusing in axially symmetric accelerators is briefly discussed, with particular attention to isochronous cyclotrons. Some numerical results on focusing and field characteristics are included. (D.C.W.)

30892 THE KARLSRUHE ISOCHRONIC CYCLOTRON. A. Kraut. Kerntechnik, 7: 82-3(Feb. 1965). (In German)

The basic physical principles of the isochronic cyclotron are briefly indicated. The engineering problems to be resolved in the maintenance of the field strengths at precise levels are discussed. The possible uses of the machine are indicated. (J.S.R.)

30893 THE GERMAN ELECTRON SYNCHROTRON. P. Joos (Deutsches Elektronen-Synchrotron, Hamburg). Kerntechnik, 7: 83-4(Feb. 1965). (In German)

The 6-Bev German Electron Synchrotron DESY was dedicated on November 12, 1964. The basic principles, design, and construction are briefly summarized. (J.S.R.)

30894 EFFECT OF SPOT SIZE ON POSITRON FOCUSING SYSTEMS. M. H. MacGregor (High Voltage Engineering Corp., Walnut Creek, Calif.). Nucl. Instr. Methods, 34: 320-4(June 1965).

Positron beams can be produced by electron bombardment of an internal converter in an electron linear accelerator. In order to increase the yield of positrons that are accelerated in the remaining length of the linac after the converter, it is desirable to use magnetic focusing of the positrons. Focusing methods that have been used are discussed. Solenoidal focusing is considered in some detail. Particular attention is paid to the problem of positron spot-size effects (off-center effects), and equations are written down that permit an evaluation of the problems encountered from these effects. (auth)

30895 CYCLOTRON SHIELDING. G. M. Budyanskii. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 185-96(1964). (In Russian)

Problems connected with cyclotron shielding as of the mid 1950's are discussed on the basis of 18 references. The neutron spectra produced by bombardment of targets with accelerated deuterons are considered, and a mathematical treatment of the attenuation of neutrons in various types of shielding is given. Particular attention was paid to concrete shielding. (CFSTI)

30896 ANALYSIS OF THE NEW METHOD FOR FOCUSING ELECTRON BEAMS. Hsing-kuon Liu. Wu Li Hsueh Pao, 21: 390-401(Feb. 1965). (In Chinese)

A new method of focusing electron beams, using simultaneously TSFT and periodic focusing, was analyzed. It was found that there were two different modes. In the first the perturbation of the motion of the electron was deduced from the oscillation equation including the effect of periodic and quasi-elastic processes, in the second the motion was derived from the heterogeneous Mathieu equations. It was found that in this method these two focusing modes are used in such a manner that they supplement each other. In this situation there is the possibility of focusing beams with a significant current. Calculated formulas are given for two concrete examples. (tr-auth)

30897 THE CALCULATION OF ELECTRON ORBITS IN THE MICROTRON. Hermann Rogenhagen (Universitat, Mainz) and Ferdinand Haberstock. Z. Angew. Phys., 19: 5-10(Feb. 1965). (In German)

In reference to the application of a cylindrical cavity resonator in the G-band microtron, the plane motion of electrons of relativistic velocity in the high-frequency electromagnetic field of a resonator placed in the homogeneous magnetic field was studied. It can be represented by a system of two non-linear simultaneous differential equations of the second order with non-constant coefficients. The system was solved with the help of an electronic analog computer and the two first electron orbits of the microtron were recorded. The investigation of a parallelepiped resonator was indicated. (tr-auth)

30898 THE BREMSSTRAHLUNG SPECTRUM OF A 500 Mev ELECTRON SYNCHROTRON. D. Husmann, D. Schmitz, and E. Weisse (Universitat, Bonn). Z. Physik, 185: 437-55(1965). (In German)

At the Bonn 500-Mev electron synchrotron the spectrum of the bremsstrahlung was investigated for several maximum-energies between 250 and 450 Mev and under various angles to the axes of the γ ray. The upper limit of the spectrum was measured carefully in respect to later experiments with photon difference method. The absolute errors of 4.5% permitted a control of the quantimeter calibration or the cross section for electron pair production. (auth)

30899 THE POSSIBILITY OF OBTAINING A PROTON PULSE WITH SMALL MOMENTUM DISPERSION. V. I. Petrunin. p.3-13 of "Elektrofizicheskaya Apparatura. Sbornik Statei, Vypusk 2." Moscow, Atomizdat, 1964. (In Russian)

The flux from a linear accelerator can be increased by preliminary grouping of the particles in the injection system; however, grouping by only a single resonator leads to a large velocity dispersion of the particles in the pulse. By adding a second grouping-device which operates at a different frequency, an almost monochromatic pulse may be obtained. Equations are developed and graphs are presented for the frequencies and phase angles. The calculations are restricted to a low-density, heavy-particle beam for which space-charge effects may be neglected. (TTT)

30900 EXCITATION OF BETATRON OSCILLATIONS BY A HIGH-FREQUENCY FIELD IN A STRONG-FOCUSING SYNCHROTRON. I. A. Shukeilo. p.56-62 of "Elektrofizicheskaya Apparatura. Sbornik Statei, Vypusk 2." Moscow, Atomizdat, 1964. (In Russian)

Equations for particle motion in a radially-constant magnetic h-f field in a synchrotron are solved by using the mutually conjugate Floquet functions. The solutions show that an ideal B-field excites betatron oscillations of the nominal frequency with an amplitude which increases linearly with time. Expressions are also developed for errors caused by inhomogeneities in the field. Applications are given to improving the focusing of the particles extracted from the synchrotron and measuring the frequencies of the betatron oscillations. (TTT)

30901 METHOD AND EQUIPMENT FOR MAGNETIC FIELD MEASUREMENTS IN STRONG-FOCUSING SYNCHROTRON IN THE RANGE FROM 500 TO 10,000 OERSTED. A. G. Alekseev, I. V. Mozin, and V. P. Smirnov. p.90-103 of "Elektrofizicheskaya Apparatura. Sbornik Statei, Vupusk 2." Moscow, Atomizdat, 1964. (In Russian)

The following parameters were determined for the magnetic field of a 6.5-Bev synchrotron: the radial distortion of the field and its gradient along the radius and the change in the relative gradient along the equilibrium orbit in the synchrotron. A differential method was used in which the relative emf from the measuring coils was electronically integrated. The electronic apparatus is described, and an error analysis is presented. The errors in measurements of the field, its gradient, and its orbital linearity are found to be 0.1, 0.1 and 0.5%, respectively. Graphs are presented of the radical variations of the orbital linearity and the distortions in the radial gradient. (TTT)

30902 EXPERIMENTAL INVESTIGATION OF A MOCKUP OF A BUNCHING SECTION OF A 50-Mev LINEAR ACCELERATOR. V. K. Khokhlov, I. A. Prudnikov, V. A. V'yalitsyn, and A. I. Nadybin. p.104-14 of "Elektrofizicheskaya Apparatura. Sbornik Statei, Vypusk 2." Moscow, Atomizdat, 1964. (In Russian)

The grouping section of a 50-Mev running-wave accelerator was studied to find the conditions for which the width of the energy spectrum was <5%, with a current ≥100 ma, a beam diameter ≤10 mm, and an angular divergence $<10^{-3}$ radians. The grouping section, 3.5 m long, consisted of 117 copper cells which were silver-plated. The case of the section was water-cooled. The magnetic field varied from 700 gauss at the beginning of the section to 200 gauss at a point 220 cm from the beginning. The klystron injector produced at 0.5 to 1.2 Mev pulse with a 2.1 μsec width, and a 10 cm wavelength, at 50 pulses/second. The pressure in the chamber was maintained at $<2 \times 10^{-5}$ mm Hg. The energy spectrum at the end of the section was measured by a magnetic analyzer with an error <1%. The following optimum parameters were determined: supply frequency, 500 kc; entrance energy 0.95 to 1.0 Mev; and entrance phase width 60°. About 48% of the injected electrons were retained in the grouping section. If preliminary grouping is done, the energy width may be maintained <1.5% under a wide range of conditions. (TTT)

30903 ELECTROMAGNETIC DEFLECTOR FOR ELECTRON EXTRACTION FROM A SYNCHROTRON. O. A. Gusev, A. P. Lebedev, and I. A. Shukeilo. p.120-30 of "Elektrofizicheskaya Apparatura. Sbornik Statei, Vypusk 2." Moscow, Atomizdat, 1964. (In Russian)

The deflector which consists of two copper foils (0.5 mm thick) separated by two insulators to form a 5×5 mm^2 gap is placed in one of the field-free sections of the synchrotron. The deflector is operated for 0.25 msec at the end of the synchrotron acceleration at a frequency of 50 cps, with a 10^4 amp current to produce a magnetic field of 5000 gauss and a magnetic pressure of 0.4 kg/cm^2. The effect of the deflecting field on the general synchrotron field can be minimized by properly choosing the width of the inner deflector foil. The power supply for the deflector is also described. (TTT)

30904 PARTICLE ENERGY REGULATION IN A CYCLOTRON WITH A PERIODIC MAGNETIC FIELD. R. N. Litunovskii. p.143-50 of "Elektrofizicheskaya Apparatura. Sbornik Statei, Vypusk 2." Moscow, Atomizdat, 1964. (In Russian)

Equations are presented for the upper and lower particle energies (W_{max} and W_{min}) in an isochronous cyclotron for which a "constant" magnetic field $H_z(R)$ can be found. If the particle energies do not lie within this range, an optimum radial (R) dependence of $H_z(R)$ can be found to keep the particles in phase. Graphs are given for the optimum acceleration of protons per orbit to obtain a given final energy W ($0 < W < 100$ Mev) in an ideal cyclotron in which there exists an energy W^0 for which the phase shift vanishes. A 1% shift from ideality occurs when $W = 0.93\ W_{max}$. A table of limits of W_{min}, W_{max} are given for a non-ideal case for the acceleration of protons to 100 Mev. (TTT)

30905 FORMATION OF PULSED ION BEAMS WITH A CURRENT ORDER OF HUNDREDS OF MILLIAMPERE IN A LINEAR ACCELERATOR. N. F. Ivanov, V. S. Kuznetsov, and A. I. Solnyshkov. p.169-78 of "Electrofizicheskaya Apparatura. Sbornik Statei, Vypusk 2." Moscow, Atomizdat, 1964. (In Russian)

Calculations are presented of the ion-optical systems of the injector of a linear proton accelerator, and experimental results for the pulse-shaping system are given. To reduce the 30- to 40-cm diameter required at the beginning of the accelerator tube to produce a 10-mm beam at the end, the beam was focused at the tube exit. The impulse is formed by an electrostatic immersion lens with two cylindrical electrodes; equations are given for its angular divergence. To avoid aberration effects the diameter of the focusing electrodes must be 3 to 4 times larger than the entrance diameter of the pulse. The strength of the immersion lens may be increased by using a metal grid at the aperture of the high-voltage electrode, which is sufficiently transparent to the beam. With this grid, the electrostatic field may be doubled. An apparatus is described for measuring the divergence of the beam and the electrostatic fields. By using the pulse-shaping system the divergence of a 450 mamp beam was halved. (TTT)

30906 ELECTRON BEAM IRRADIATION APPARATUS. Jacques Muel (to Commissariat a l'Energie Atomique). British Patent 988,025. Mar. 31, 1965. Priority date Jan. 30, 1962, France.

A simple apparatus is described for the formation of a stable, homogeneous electronic flat beam of high definition and of adjustable width and thickness. The irradiation apparatus includes an elongated cathode assembly emitting a flat beam of electrons having substantially parallel propagation paths. The cathode is located in an evacuated envelope provided with a window assembly for the emergence of the electrons. A magnetic focusing means is located between the cathode assembly and the window. The lines of force of the field are substantially perpendicular to the propagation axis of the beam and parallel to the beam at least in the central portion. The focusing means consists of at least one pair of straight permanent magnets or electrical coils located parallel to the beam and symmetri-

cally one on each side. The coils or magnets are polarized in opposite directions. (B.L.M.)

30907 IONIC IRRADIATION OF MATTER. Bernhard Berghaus (to Elektrophysikalische Anstalt Bernhard Berghaus). Canadian Patent 688,157. June 9, 1964. Priority date Oct. 2, 1957, Switzerland.

A method and apparatus are provided for the production of a strong ion current. An ionized gas jet is employed in which charge carriers of one polarity are continuously concentrated. The apparatus is particularly suitable for the performance of reactions in gaseous, vaporous, or finely dispersed materials under the action of electric glow discharges within a reaction vessel in a zone of increased pressure. Preferably the apparatus is composed of a reaction chamber and a separate chamber upstream from the reaction chamber. The optimum operating pressures are 5 mm Hg to several atmospheres in the reaction chamber and 200 mm Hg to 50 atm in the separate chamber. A gas discharge is produced in the separate chamber between the downstream walls and an upstream electrode having a potential relative to the walls and thus effecting the ionization and enrichment of the gas stream. Electrical or magnetic fields are provided to control the direction of flow of the gas stream. (B.L.M.)

30908 CRASH ENERGY ABSORBER FOR HEAVY APPARATUS. Jack Arthur Roskelley (to U. S. Atomic Energy Commission). U. S. Patent 3,181,653. May 4, 1965.

A compact emergency stopping device is designed for absorbing the kinetic energy of moving heavy apparatus. The device was developed to prevent damage to a charged-particle accelerator by a four-ton beam extraction magnet, which is plunged at a maximum velocity of 10 feet per second, in the event that the magnet mounting should fail in the course of a plunge. The device includes a plurality of pointed shafts which project from the element to be stopped in the direction of the undesired travel. A stack of spaced parallel plates are anchored in a stationary position in the path of the shafts in transverse relationship thereof. Momentum of the moving element is thus dissipated through progressive penetration of the plates by the shafts with no tendency to rebound being present. (AEC)

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Refer also to abstract 31376.

30909 (AD-611323) DOSIMETRIC EVALUATION OF THE ALPHA FLUX IN SOLAR PARTICLE BEAMS. Report No. 30. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). Nov. 30, 1964. 27p. $2.00(CFSTI).

Depth distributions of absorbed doses and dose equivalents in tissue are computed for the alpha and proton components of a typical rigidity spectrum of a large flare assuming a flux ratio of one to one. Even for the lowest investigated shield thickness of 1.75 g/cm^2 the total alpha dose is smaller than the proton dose and becomes even smaller with depth. The fractional high linear energy transfer alpha dose, however, is substantially larger than the corresponding proton dose and intersects the latter at 12 g/cm^2 depth in tissue. In spite of this, the combined mean local relative biological effectiveness of the total dose is predominantly determined by the protons. The findings indicate that the alpha component of flare beams creates a significant additional exposure only for cases of very low shielding, such as an astronaut outside the vehicle protected merely by the space suit. (auth)

30910 (EUR-1819.e(p.59-61)) ABOUT THE PRESENCE OR ABSENCE OF NICKEL AND COBALT IN ABLATION PRODUCTS OF IRON METEORITES. K. Utech and H. Fechtig (Max-Planck-Institut fuer Kernphysik, Heidelberg (West Germany)).

The formation of cosmic spherules by ablation of iron meteorites in the atmosphere was studied using a microanalyzer. Spherules extracted from sediments laid down ~150 million years ago were found to have almost no Ni or Co, and hollow cores were found where the nuclei were located, while younger spherules had Ni and Co. A melting experiment was conducted on meteoritic iron and on an artificial Ni–Fe alloy; a fusion crust was formed, and the microanalyzer showed that Ni and Co diffused from the crust into a thin layer below the crust. The dissolution of nuclei to form hollow cores is discussed. (D.L.C.)

30911 (IC/65/30) CONSIDERATIONS AROUND SO-CALLED COSMOLOGICAL PROBLEMS. Notes of a Lecture. O. Klein (International Centre for Theoretical Physics, Trieste (Italy)). Mar. 1965. 18p. Dep.(mn).

The main ideas of Einstein's general relativity theory are outlined briefly, including the equivalence principle and the claim of general relativity, the use of the Minkowski invariant, and the development of field equations; the Schwarzschild-Droste solution for the gravitational field outside of a spherical distribution of matter and the Schwarzschild static solution of the field inside a sphere of incompressible matter of constant density and pressure are considered. The Einstein static closed universe theory of cosmology is discussed, reviewing its claims of avoidance of boundary conditions and the hope of satisfying Mach's principle. Friedmann cosmology and the Friedmann solutions corresponding to pressureless matter with density a function of time are considered. The theory that the metagalaxy is not representative of the universe at large but just one member of a system of higher order in the sense of Charlier is discussed. Eddington's relations between the dimensions of a closed model of the universe and certain atomic quantities, indicating a bounded, open-system metagalaxy whose evolution is governed by the combined action of gravitation and radiation pressure, are discussed. Alfven's theory of magnetic separation of matter and antimatter and matter-antimatter annihilation as an energy source instrumental in early metagalactic evolution is mentioned. (M.J.T.)

30912 ON SOLAR FLARES AND GEOMAGNETIC SOLAR FLARE EFFECTS (s.f.e). Folke Eleman. Arkiv Astron., 3: 37-49(1962).

A presentation is given of some results of flare observations made at the Swedish Astrophysical Station at Anacapri. Photometric data are given for the two giant flares of July 3, 1957, and March 23, 1958. The disturbance in the geomagnetic field produced by the electromagnetic radiation of a solar flare (s.f.e.) is discussed on the basis of observational material for the great flare of March 23, 1958. A review of present research concerning the ionospheric current systems producing s.f.e.'s is given. Finally, some statistical results from the Swedish Geomagnetic Observatory, Lovö, are presented. (auth)

30913 A PHOTOMETRIC STUDY OF ACTIVATIONS OF PROMINENCES PROBABLY DUE TO MOVING DISTURBANCES ON THE SUN. Y. Oehman, A. Lindgren, and Ulla Lindgren. Arkiv Astron., 3: 121-6(1963).

Visual photometric measurements were made of quiescent prominences with a Savart photometer for the purpose of studying changes in their brightness possibly due to moving disturbances originating in solar flares. Some fairly clear cases of sudden increase in intensity are described, indicating propagation rates of about 80 km/sec. The disturbances seem to be more related to the phenomenon first described by A. Bruzek than to the fast moving disturbances detected by G. E. Moreton. (auth)

30914 A SUNSPOT GROUP OF HIGH ACTIVITY IN JULY 1961. Kerstin Fredga. Arkiv Astron., 3: 127-36 (1963).

The observation, development, and associated activity of the sunspot group in July 1961 are discussed. Tables of flares, surges, and active prominences during this period are included. (C.E.S.)

30915 VISUAL PHOTOMETRIC MEASUREMENTS OF SUNSPOTS, FRAUNHOFER LINES AND COLOUR TEMPER-

ATURE. Nils-Johan Bergsjoe. Arkiv Astron., 3: 203-13 (1963).

The measurement of sunspots, the intensity ratio as a function of limb distance, the limb darkening function in a sunspot, measurements of the equivalent widths of some Fraunhofer lines, and measurements of color temperature are discussed. The equipment used is briefly described. (C.E.S.)

30916 THE NEW PHOTOELECTRIC PHOTOMETER OF THE UPPSALA OBSERVATORY. PRELIMINARY RESULTS FOR A FIELD IN CASSIOPEIA (SA 19). T. Elvius, P.-I. Eriksson, H. Linden, and B. Ljunggren (Astronomical Observatory, Uppsala). Arkiv Astron., 3: 317-23(1964).

After a survey of the actual photoelectric activities at the Uppsala Observatory, and a summary of previously published photoelectric results, the new photometer constructed at this observatory is briefly described. To demonstrate its efficiency, photoelectric data are given for a sequence of stars in Cassiopeia (Kapteyn's Selected Area 19). (auth)

30917 ON THE LARGE PROMINENCE OF APRIL 12-14, 1963. Ludwik Liszka. Arkiv Astron., 3: 325-31(1964).

The large prominence of April 12–14, 1963 and the simultaneous solar activity are discussed. Apparent motions of the prominence and influence of the bright surges on the prominence are described. Terrestrial effects of the sudden disappearance of the prominence are briefly outlined. (C.E.S.)

30918 A SUNSPOT GROUP OF HIGH SURGE ACTIVITY IN JUNE 1963. Ludwik Liszka. Arkiv Astron., 3: 349-56 (1964).

The sunspot group observed in June 1963 is discussed. The group extended at its maximal phase over more than 10 degrees of heliographic longitude. The observed flare activity was comparatively low, although large and active plage areas occurred in the group. The group was characterized by a large occurrence frequency of dark surges. The largest of them, at least of importance 3, was observed on June 12. It was found that the activity of the group had no distinct ionospheric effects. (C.E.S.)

30919 SMALL-ANGLE SCATTERING OF CELESTIAL X-RAYS BY INTERSTELLAR GRAINS. James W. Overbeck (Massachusetts Inst. of Tech., Cambridge). Astrophys. J., 141: 864-6(Apr. 1, 1965).

The theory of scattering of x rays by grains is reviewed, and it is shown that in typical situations a measurable fraction of celestial x rays will have been scattered. This will appear observationally as an increase in the apparent angular width of celestial x ray sources. (auth)

30920 STELLAR EVOLUTION. I. THE APPROACH TO THE MAIN SEQUENCE. Icko Iben, Jr. (California Inst. of Tech., Pasadena). Astrophys. J., 141: 993-1018 (Apr. 1, 1965).

The manner in which nuclear reactions replace gravitational contraction as the major source of stellar luminosity is investigated for model stars of population I composition in the mass range $0.5 < M/M_{\odot} < 15.0$. By following in detail the depletion of ^{12}C from high initial values down to values corresponding to equilibrium with ^{14}N in the C-N cycle, the approach to the main sequence in the Hertzsprung-Russell diagram and the time to reach the main sequence, for stars with $M \geq 1.25\ M_{\odot}$, are found to differ significantly from data reported previously. (auth)

30921 STUDIES IN STELLAR EVOLUTION. I. THE INFLUENCE OF INITIAL CNO ABUNDANCES IN A STAR OF MASS 2.3. Peter Bodenheimer, J. E. Forbes, Nancy L. Gould, and L. G. Henyey (Univ. of California, Berkeley). Astrophys. J., 141: 1019-42(Apr. 1, 1965).

A series of evolutionary sequences have been calculated for a configuration of mass 2.3 $M_{\odot}$. They cover late pre-main-sequence and main-sequence evolution and differ in their initial chemical compositions. Sequence I begins with concentrations of C, N, and O similar to observed atmospheric values published for stars predominantly of Population I. The C/N and O/N ratios are considerably in excess of their equilibrium values, and there is found to be a pre-main-sequence adjustment period of carbon burning causing an additional pre-main-sequence dip in luminosity on the Hertzsprung-Russell diagram. Sequence IV shows that the dip becomes less marked if the total heavy-element concentration is reduced. Sequence II begins with nearly equilibrium abundances of ^{12}C and ^{14}N and the carbon dip is not seen. Sequence III illustrates the effect of increasing the O/N ratio and confirms that ^{16}O is only very gradually converted to CN isotopes. In a series of appendices the physical approaches and approximations used in these calculations are described. They are intended to supplement the basic discussion of the numerical technique. They treat the equation of state, opacity, chemical composition changes due to hydrogen burning, chemical homogenization of convective regions, and the obtaining of a starting configuration for an evolutionary sequence. (auth)

30922 RANDOM MICROSCOPIC MAGNETIC FIELDS IN A PLASMA. Charles L. Hyder (Univ. of California, Los Angeles) and James W. Warwick. Astrophys. J., 141: 1117-18(Apr. 1, 1965).

Magnetic fields that are uniform over distances large compared to interatomic spacings yield observable effects in the structure and polarization of many spectral lines. However, local, microscopic fields may dominate a weak uniform field at an atom in a plasma. For this situation to develop, the electron densities usually exceed 10^{14} cm^{-3}, and the electron temperatures exceed 10^{4}°K. (auth)

30923 ON THE OPTICAL POSITION OF THE STELLAR OBJECT ASSOCIATED WITH THE RADIO SOURCE MSH 14-121. P. Veron (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). Astrophys. J., 141: 1284-5(Apr. 1, 1965).

It is pointed out that from the optical position of the MSH 14-121 stellar object relative to the two radio components the peculiar continuous optical spectrum of the star, which is characteristic of the quasi stellar source, cannot be associated with the radio spectrum as in the case of 3C 48 and 3C 196. (L.B.S.)

30924 LARGE REDSHIFTS OF FIVE QUASI-STELLAR SOURCES. Maarten Schmidt (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). Astrophys. J., 141: 1295-1300(Apr. 1, 1965).

The emission spectra of five quasi-stellar radio sources were studied and the redshifts, line identifications, and computed rest wavelengths are reported. The intrinsic properties of the sources such as the radio flux, optical flux, and linear diameter were determined and compared with those of four sources with previously known redshifts. (L.B.S.)

30925 ON THE THEORY OF THE RADIO EMISSION OF VENUS. A. D. Kuzmin (Lebedev Inst. of Physics, Moscow). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 7-18 (1965). (In Russian)

Analytic relations are given, connecting the brightness temperature of the radio emission of a planet surrounded by an absorbing atmosphere with the physical parameters of its surface and atmosphere. Numerical solutions are obtained for the particular cases of absorption by the whole thickness of the atmosphere and absorption in homogeneous and parabolic layers. The solutions are applied to the interpretation of results of radioastronomical measurements of Venus. (auth)

30926 THE DETERMINATION OF SOME EXTRA-GALACTIC RADIO SOURCE DECLINATIONS BY MEANS OF BIG PULKOVO RADIOTELESCOPE. V. Ya. Gol'nev, and G. G. Novozhilova, and Yu. N. Parijskii (Main Astronomic Observatory, Academy of Sciences, USSR). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 183-5(1965). (In Russian)

Results of a determination of the declination of a number of discrete sources of radio emission of metagalactic origin at the wavelength of 6.4 cm are presented. Obser-

vations were made in the eastern azimuth, in the meridian, and in the western azimuth, at A = +14°24′, 0, and −14°24′ respectively, using at least four curves of transit for a confident determination of the moment of transit of the source across the pattern of the antenna. Results are compared with previous measurements. (M.J.T.)

30927 INVESTIGATION OF SOLAR X-RAY EMISSION. IV. MEASUREMENT OF THE RADIATION FLUX IN THE SPECTRAL REGION 2-18 A. I. P. Tindo and A. I. Shurygin. Kosmich. Issled., 3: 262-7(Mar.-Apr. 1965). (In Russian)

The results are presented of measurements of the solar x-ray flux made in the region of the spectrum from 2 to 18 Å during vertical launchings of geophysical rockets to an altitude of about 500 km. The cooler temperature of the emission in this region of the spectrum was determined; the results of the measurements are comparable to calculated values. (tr-auth)

30928 AN ASTROPHYSICAL THEORY FOR AURORAL FLUCTUATIONS. R. S. Iyengar (Mount Allison Univ., Sackville, New Brunswick, Can.). Nature, 206: 571-3 (May 8, 1965).

A model is considered for some of the auroral fluctuations that might arise from the atmospheric dynamics or from the motion of auroral luminescence across the field of view. In such a complex phenomenon as the aurorae, it cannot be denied that several types of effects may well be combined. It is pointed out that one such effect is the contribution of the medium itself. From the results, it was concluded that the Fresnel diffraction model for fluctuations in optical and radiowave-lengths may be thought of at 100 km. Some of the auroral fluctuations may be due to the same effects as affect the galactic light at this level. Motion of auroral luminescence relative to the irregularities of the optical path may cause some fluctuation effects. The sizes of the irregularities may range from less than 1 km to a few km. (P.C.H.)

30929 POSSIBLE ANTI-MATTER CONTENT OF THE TUNGUSKA METEOR OF 1908. Clyde Cowan (Catholic Univ. of America, Washington, D. C.), C. R. Atluri, and W. F. Libby. Nature, 206: 861-5(May 29, 1965).

A spectacular meteor fall was observed on June 30, 1908, at $0^h\ 17^m\ 11^s$ U.T. in the basin of the Podkanemaia Tunguska River, Siberia (60° 55′ N, 101° 57′ E), some 500 miles to the north of Lake Baykal. Various hypotheses have been advanced to explain the massive phenomena as having been caused by a large meteor, a small comet, or a nuclear explosion. If this were the result of a nuclear explosion of some sort, then the yield of neutrons into the atmosphere with the consequent formation of ^{14}C from atmospheric nitrogen should be detectable by analysis of plant material that was growing at that time. The growth rings of a tree were thus analyzed. Although there are uncertainties in both the estimate of the expected radiocarbon yield on the basis of the anti-matter hypothesis for the Tunguska meteor and in any extra radiocarbon burden of the atmosphere in the years following 1908, the data do yield a positive result. They appear to set an upper limit of $\frac{1}{7}$ for the fraction of the meteorite's energy which could have been due to anti-matter. (P.C.H.)

30930 STRUCTURE OF QUASI-STELLAR RADIO SOURCES. T. K. Menon (National Radio Astronomy Observatory, Green Bank, W. Va.). Nature, 206: 810-11(May 22, 1965).

The development and properties of quasi-stellar radio sources are discussed in terms of shell structure by which the shape of the spectrum of radio sources below the turnover frequency can be explained. (D.C.W.)

30931 THE QUASARS AND THEIR VERY LARGE AND VARIABLE LIGHT EMISSION. S. M. W. Ahmad (A. Reyrolle and Co. Ltd., Hebburn, Eng.). Nuovo Cimento (10), 37: 1761-5(June 16, 1965).

A theory concerning quasars is presented. It is proposed that the very intense light emission from the quasars results from the 100% conversion of the mesons (π^0) into radiation on a much larger scale than is possible in the physical conditions of the sun and other stars. The cyclic variations of the light emission result from the cyclic changes in the magnetic field of the quasars. (C.E.S.)

30932 MOTION OF GASES IN THE SUN'S ATMOSPHERE. A. K. Das (Osmania Univ., Hyderabad, India). Proc. Natl. Inst. Sci. India, Pt. A, 30: 283-313(May 26, 1964).

A theory of the sun's photosphere and the layers of the surrounding envelope is outlined. The formation and motion of prominences and sunspots are considered, together with the magnetic polarity of sunspots and the presence of highly ionized atoms in the corona. (D.C.W.)

30933 CONTRACTION OF A PROTOSTAR UP TO THE STAGE OF QUASI-STATIC EQUILIBRIUM. Hayashi, Chushiro; Nakano, Takenori (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 33: 554-6(Mar. 1965).

The results are summarized of an investigation of the evolution of the star of one solar mass, after its birth, to the stage of wholly convective and quasi-static equilibrium, through the so-called forbidden region in the HR diagram. The dynamical and thermal properties of the star were studied over great ranges of density and temperature, with particular consideration of the dependence of evolution on the initial conditions and on the dissociation of H_2 molecules and the ionization of H atoms. (D.C.W.)

30934 NEGATIVE MASS. Banesh Hoffmann. Sci. J., 1: No. 2, 74-8(Apr. 1965).

The concept and properties of negative mass are discussed, and a possible explanation of the energy output of quasars in terms of negative mass is outlined. (D.C.W.)

30935 SOLAR ACTIVITY DURING THE FIRST 14 MONTHS OF THE INTERNATIONAL YEARS OF THE QUIET SUN. Helen W. Dodson, E. Ruth Hedeman, and Frederic L. Stewart (Univ. of Michigan, Pontiac). Science, 148: 1328-31(June 4, 1965).

Solar data for the interval January 1964 through February 1965 are reported and discussed. The first 14 months of IQSY included a minimum in solar activity, insofar as solar activity is measured by sunspot number, the area and intensity of calcium plages, and daily flux at 2800 Mcy/sec. According to these three parameters the interval May to November 1964 was flanked by periods of increased solar activity, and July 1964 was the quietest month within the interval. (P.C.H.)

30936 CONTEMPORARY STATE OF THE THEORY OF SUPERDENSE HEAVENLY BODIES. V. A. Ambartsumyan and G. S. Saakyan. Vopr. Kosmogonii, Akad. Nauk SSSR, 9: 91-131(1963). (In Russian)

The contemporary state of the theory of very dense stellar configurations in which the temperature is substantially lower than the degeneracy temperature and is not a member of the equation of state is reviewed. Electron and baryon configurations are distinguished; in these configurations the degenerated gas pressure is determined by electrons (white dwarfs) or baryons (neutron and hyperon configurations), respectively. Baryon configurations should have very powerful gravity fields; hence the theory of relativity must be used in their study. A baryon configuration may consist of 4 basic regions: a baryon central nucleus (excited nucleus), a hyperon layer, a neutron layer, and a surface layer consisting of protons, electrons, and nuclei. The central density is the chief characteristic of the configuration. The mass and radius of a configuration depends on the form of the equation of state. (auth)

30937 ^{36}Cl PRODUCED BY SPALLATION REACTIONS AND NEUTRON CAPTURE IN METEORITES AND THE PRE-ATMOSPHERIC SIZE OF STONE METEORITES. F. Begemann and E. Vilcsek (Max-Planck-Institut fur Chemie, (Mainz). Z. Naturforsch., 20a: 533-40(Apr. 1965). (In German)

The ^{36}Cl produced by spallation reactions and neutron capture on ^{35}Cl was measured separately in three stone

meteorites and one iron meteorite. The spallation produced ^{36}Cl activities—given in dpm per kg (Fe + Ni + 10 × Ca)—were found to be (20.5 ± 2) for Abee-Centre, (21.8 ± 2) for Abee-Surface, (21.3–26.2) for Leedey, and ≤(22 ± 10) for Norton County-Surface. They are in good agreement with those found in iron meteorites of comparable size and known terrestrial age. The neutron induced activities in the same samples were (0.21 ± 0.2), (0.8 ± 0.17), (1.7 ± 1), and ≤(30 ± 15) dpm/100 mg Cl. In spite of the large uncertainties highly significant conclusions can be drawn from these data regarding the mass loss of the meteorites during approximately the last million years, either by space erosion or due to ablation during the passage through the terrestrial atmosphere. Based on calculations of others the ratio of post-atmospheric to pre-atmospheric radius derived for the three meteorites is Abee: $r_M/R = 0.86$ or $r_M/R > 0.7$ on the 3σ significance level, Leedey (meteorite shower): $r_M/R = 0.5$, and Norton County: $r_M/R = 0.77$ or $r_M/R > 0.63$ (3 σ level). No neutron induced activity could be detected in the iron meteorite Cranbourne (Nr.4). The total and spallation produced ^{36}Cl of two adjacent samples—although differing in their Cl content by more than a factor of twenty—was the same within the experimental limits of error (4.7 ± 0.2) dpm/kg. The low value is attributed to a high terrestrial age and/or the size of this meteorite. ^{39}Ar could not be detected (<0.64 dpm/kg, 3σ level). (auth)

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Refer also to abstract 30264.

30938 (AD-607661) ELECTRON-IONIZATION CROSS SECTIONS. Semiannual Progress Report No. 1, June 15–December 15, 1963. C. K. Crawford and C. E. Woodward (Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research). Contract AF33(657)-10939. 18p. $1.00(CFSTI).

Work was devoted to improving the existing equipment. Work areas included the completion and testing of an ultra-high-gain electron multiplier, the installation of a new quadrupole lens, construction of a simple gas test source, testing of the spectrometer, construction of a new pulse quantizer, theoretical exploration of the ion transmission between the spectrometer and the electron multiplier, and studies of the data-handling problems in the pulse electronics. Except for a tendency to short out, the new electron multiplier operates satisfactorily, whereas the new quadrupole lens does not. The pulse electronics has yet to be connected to the multiplier output. Measurement of ionization cross sections is still several months distant. (auth)

30939 (AD-609168) MEASUREMENT OF ATOMIC COLLISION CROSS SECTIONS. Final Report, December 1, 1958–November 30, 1964. R. F. Stebbings (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Nov. 27, 1964. Contract Nonr-2786(00). 58p. (GA-5861). $3.00(CFSTI).

The production of Lyman-alpha radiation in H(+)-H (1s) collisions has been investigated. The cross sections for 1s-2p excitation of the thermal-energy-target H atoms, and for electron capture into the 2p state of the projectiles, have been determined separately. These measurements are of particular significance in that they provide experimental information on a heavy-particle inelastic collision, involving only one electron, in which the states of all interacting particles are determined. Comparison with the results of calculation subjects the validity of the scattering approximations to direct scrutiny. It appears that the low energy behavior for both excitation and capture is adequately represented by theory as is the high-energy behavior for electron capture. The calculations appear to over-estimate the cross section for 1s-2p excitation by about a factor of 2 at the high energies. Electron impact ionization of molecular oxygen was investigated in the immediate vicinity of threshold using electron beams of high energy-resolution. The results suggest that a re-evaluation of the mechanism of the ionizing process may be necessary. (CFSTI)

30940 (AD-609418) THE SPECTRUM OF DOUBLY IONIZED PRASEODYMIUM. Johns Hopkins Spectroscopic Report No. 22. J. Sugar (John Hopkins Univ., Baltimore, Md. Dept. of Physics). Dec. 1961. Contract AF49(638)-535. 64p. (AFOSR-4543). $3.00(CFSTI).

The spectrum of Pr^{2+} (PrIII) produced by a low-energy spark discharge in helium was observed from 2025 to 10716 Å. The resulting line list contains about 4,000 entries, some 1600 of which have been classified in an energy level scheme consisting of 118 odd and 130 even levels. Almost all the expected levels of the 4f(3), 4f(2)5d, 4f(2)6p configurations have been located, as well as some levels of the 4f5d2 and 4f(2)6d groups. The ground state of the ion was found to be the $^4I_{\frac{9}{2}}$ level of the 4f(3) configuration. The structure of the 4f(2)6s and 4f(2)6p groups indicate well developed $J_{1}j$-coupling, while the remaining configurations were interpreted in terms of LS-coupling. An ionization potential of 23.2 volts was obtained from levels of the two member 4f2nd series. (auth)

30941 (AD-609419) THE SPECTRA OF DOUBLY AND TRIPLY IONIZED YTTERBIUM. Johns Hopkins Spectroscopic Report No. 21. Barry W. Bryant (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). Sept. 1961. Contract AF49(638)-535. 101p. (AFOSR-4544). $4.00 (CFSTI).

The emission spectrum of ytterbium was photographed under varied conditions from 600 to 11,000 Å in order to obtain a complete description of the spectra of the doubly and triply ionized species. The main transition arrays of these species were identified, and where feasible, the analysis carried through. All 41 energy levels, 28 odd and 13 even, belonging to the 4f(14), 4f(13)5d, 4f(13)6s, 4f(13)6p, and 4f(13)7s configurations of YbIII were experimentally determined along with the appropriate quantum numbers. Eleven of 20 possible 4f(13)6d levels and their quantum numbers were also determined. One hundred ninety-three lines were classified in the YbIII energy level scheme with an average deviation of ±0.05/cm. All the YbIII levels are supported by intermediate coupling calculations. The two 4f(13) levels of YbIV were determined in addition to 20 of a possible 107 4f(12)5d levels, of which a few are expected to be fortuitous. (auth)

30942 (LA-3268) A QUANTUM- AND CORRELATION-CORRECTED THOMAS-FERMI-DIRAC EQUATION WITH A FORTRAN CODE. John F. Barnes (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Apr. 2, 1965. Contract W-7405-eng-36. 46p. Dep.; $3.00(cy), 2(mn) CFSTI.

Previously, a "quantum correction" to the statistical model of the atom was derived in detail. In the present work these results and a very simple approximation to the correlation energy are used in deriving a quantum- and correlation-corrected Thomas-Fermi-Dirac (TFD) equation. One expects the radial density distribution and potential calculated from this equation to be improved over those on the TFD model, both near the nucleus and near the outer boundary of the atom or ion. Minimum-energy (that is, zero boundary pressure) solutions for rare-gas atoms possess values of cell radius in good agreement with those calculated from experimental values of the lattice parameter. A Fortran code is included. (auth)

30943 (N64-20594) NONADIABATIC THEORY OF INELASTIC ELECTRON-HYDROGEN SCATTERING. H. L. Kyle (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Apr. 1964. 79p. (X-641-64-98; NASA-TMX-51667). $7.60 (CFSTI).

A brief history is given of the experimental measurements of the probability for the excitation of atomic hydrogen from the H(1s) state to the H(2s) state by electron impact. The experiments leave the excitation cross section, σ_{1s-2s} uncertain by as much as a factor of 2 between 10.2 and 50 ev. A brief description of the close coupling approximation is given, and the desirability of an alternate method of approach is suggested. A formalism for the nonadiabatic treatment of the scattering of low energy

s-wave electrons from atomic hydrogen was developed, and the zeroth order (angle-independent) approximation is explicitly solved. The solution was effected by expanding the wave function in terms of separable solutions. The elastic cross sections, $\sigma_{1s\text{-}1s}$ are within 1% of the close coupling results in the triplet case, but are about 20% greater in the singlet case. The inelastic cross sections, $\sigma_{1s\text{-}2s}$ are reduced about 20% in the triplet case and 20% to 40% in the singlet case relative to the close coupling results. (auth)

30944 (NIJS-R-433) SURFACE TOPOGRAPHY OF ION-BOMBARDED SODIUM CHLORIDE CRYSTALS. V. Marinkovic and B. Navinsek (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). July 1963. 5p. (CONF-806-3). Dep.(mn).

From 3rd European Regional Conference on Electron Microscopy, Prague, Aug.-Sept. 1964.

Observations were made on carbon replicas of NaCl single crystals which were bombarded by 2–4 kev argon ions at 50 to 300 μamp/cm^2. The surface changes at current densities less than and greater than 150 μamp/cm^2 are described, and mechanisms for the spike formation are discussed. (D.L.C.)

30945 (TID-21817) COLLISION-INDUCED MIXING IN THE FIRST EXCITED STATES OF THE ALKALIES (thesis). James Adam Jordan, Jr. (Michigan Univ., Ann Arbor). 1964. Contract AT(11-1)-1112. 122p. Dep.(mn); $4.00 (cy), 3(mn) CFSTI.

Cross sections for noble-gas induced transitions between fine structure levels in the first excited states of alkali atoms were determined experimentally and theoretically. Calculations were performed for the leading terms in the electrostatic interaction between the noble gas and alkali atoms; detailed consideration was given to the van der Waals and dipole-quadrupole terms. The theory of the experiments is discussed, considering the gas kinetic rate equations applicable to mixing between fine structure levels. The transfer of excitation from one of the fine structure levels to the other was measured as a function of noble gas pressure, using resonance fluorescence techniques; results are given for sodium- and potassium-noble gas mixtures. (M.J.T.)

30946 (UCRL-7700) CHARACTERISTIC X-RAY PRODUCTION IN THE K SHELL OF MAGNESIUM AND ALUMINUM BY 25- TO 100-kev PROTONS. R. D. Worley, D. L. Potter, and J. M. Khan (Lawrence Radiation Lab., Univ. of California, Livermore). May 13, 1964. Contract W-7405-eng-48. 16p; Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Characteristic x rays from the K-shell of magnesium and aluminum were produced by proton bombardment. Thick-target yields were obtained for proton energies between 25 and 100 kev. Using appropriate values for the stopping power and fluorescent yields of 0.021 for magnesium and 0.029 for aluminum, the following range for the ionization cross section of the K-shell was obtained: for magnesium, $2 \times 10^{-25} - 1.6 \times 10^{-22}$ cm^2; and for aluminum, $4.9 \times 10^{-24} - 5.3 \times 10^{-23}$ cm^2. A thin-window, flow-mode proportional counter was used to detect the x rays. (auth)

30947 (UCRL-16034) TOTAL SPIN-EXCHANGE CROSS SECTIONS FOR ALKALI ATOMS FROM OPTICAL PUMPING EXPERIMENTS (thesis). Hyatt McDonald Gibbs (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 12, 1965. Contract W-7405-eng-48. 202p. Dep. (mn); $6.00(cy), 4(mn) CFSTI.

The importance of the nuclear pins in the analysis of alkali spin-exchange experiments employing Zeeman optical pumping by circularly polarized light and performed in low magnetic fields is demonstrated. The signal for general nuclear spin is found for the Franzen-type transient experiment and for the Dehmelt-type steady-state experiment in the limit of low light intensity. The results are quite sensitive to the process assumed for the relaxation of the ground-state populations. The solutions are given for a general process in which randomly oriented disorientation fields interact with the spins of the alkali atom only through the electron spin. The steady-state signal expression includes the effects of self spin exchange and partial disorientation in the excited state. Only the diagonal elements of the density matrix are included. A hyperfine optical pumping experiment employing the Franzen transient method is described in detail. It was applied to the most precise determination to date of the total spin-exchange cross sections $\sigma_{^{87}Rb-^{87}Rb} = (2.03 \pm 0.20) \times 10^{-14}$ cm^2 and $\sigma_{^{87}Rb-^{133}Cs} = (2.18 \pm 0.31) \times 10^{-14}$ cm^2. A scanning Fabry-Perot interferometer is used in estimating the densities of the alkali vapors. Problems introduced by the Fabry-Perot and overlooked in the past are discussed. (auth)

30948 (AERE-Trans-1018) ON THE EXCITATION OF ATOMS OF ALKALI METALS. L. Vainshtein, V. Opykhtin, and L. Presnyakov (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated by G. A. Thompson (Atomic Energy Research Establishment, Harwell (England)), from report A-53. 1964. 17p. Dep.; $0.60(BIS), 3s.(HMSO).

The model developed in an earlier publication was generalized for application to any atom. On the basis of both this model and the close coupling method, the excitation of alkali metal atoms by collision with electrons is considered. For non-resonance levels, excitation near the threshold proceeds mainly through an intermediate level. When $E < 3\Delta E$ (and for all E values, in the case of resonance levels), the model agrees well with the excitation cross section. (auth)

30949 ON THE EXISTENCE OF A MAXIMUM PRINCIPLE AS AN EQUIVALENT CHARACTERIZATION OF THE THOMAS-FERMI-DIRAC MODEL AND THE THOMAS-FERMI-DIRAC INTERACTION POTENTIAL OF ATOMS. K. Guenther (Zentralinstitut fur Kernforschung, Rossendorf, Ger.). Ann. Physik, 14: 296-309(Nov. 1964). (In German)

The maximum principle, introduced by Abrahamson, A. A., Hatcher, R. D., and Vineyard, G. H., (Phys. Rev., 121: 159 (1961)) as an equivalent characterization of the Thomas-Fermi-Dirac model for neutral (but not necessarily spherical-symmetrical) electron systems, was investigated under conditions of variation in the surface of the electron cloud. No maximum was found in the energy-equivalent extreme value. It was also concluded that the interaction potentials of the atoms calculated on the basis of this principle are erroneous. (auth)

30950 INTERATOMIC POTENTIALS AND X-RAY-DIFFRACTION INTENSITIES FOR LIQUID XENON. Ashfaq A. Khan and A. A. Broyles (Univ. of Florida, Gainesville). J. Chem. Phys., 43: 43-8(July 1, 1965).

The experiments performed by Campbell and Hilderband provided intensity curves for x rays scattered from liquid xenon. They have computed, from their data, the radial distribution functions g. The Lennard-Jones 6-12 potential with constants suggested by Bettie, Barriault, and Brierly and the Slater potential with Kane's constants were used to compute g's and scattering intensities for comparison with those of Campbell and Hilderband. The agreement between experiment and theory was poorer than that found for neon, argon, and krypton, and arguments are presented why the experimental intensities should be remeasured. (auth)

30951 PRESSURE SHIFTS IN THE ^{23}Na HYPERFINE FREQUENCY. Alan T. Ramsey and L. Wilmer Anderson (Univ. of Wisconsin, Madison). J. Chem. Phys., 43: 191-4(July 1, 1965).

The density shifts of the ^{23}Na ground-state hyperfine frequency were measured in He, Ne, Ar, Kr, Xe, H_2, and N_2, giving shifts of 130, 80, 5, –75, –150, 110, and 87 cps/mm of Hg, respectively, with pressures measured at 23°C. The average zero-density hyperfine frequency was 1 771 626 150 ± 250 cps. The temperature dependence of the density shifts was measured for He, Ne, Ar, and N_2. (auth)

30952 VIBRATIONAL EXCITATION OF HYDROGEN MOLECULE BY SLOW ELECTRONS. Kazuo Takayanagi

(Saitama Univ., Urawa, Japan). J. Phys. Soc. Japan, 20: 562-5(Apr. 1965).

The Born approximation is applied to the study of relative importance of various parts of the interaction between an incident electron and a hydrogen molecule in exciting vibration of H_2. It is found that the polarization force is most important. The distorted-wave method is then applied to obtain a more reliable cross section. The resulting cross section has a magnitude comparable to experimental data reported by Engelhardt and Phelps and by Schulz. The calculated cross section is finite over the whole energy region beyond the threshold in contrast with the Schulz cross section, which is negligibly small until the incident energy becomes nearly twice the threshold energy. (auth)

30953 HIGH-ENERGY NUCLEAR PHYSICS. ACHIEVEMENTS AND FUTURE DEVELOPMENTS. C. C. Butler (Imperial Coll. of Science and Tech., London). Nature, 206: 763-9(May 22, 1965).

A review is presented on the main landmarks in the investigation of matter, from some of the bulk properties to those of the basic component particles. Discussion is presented on the Earth, Sun, and the planets, the atom and its structure, and also into still smaller spaces, into the structure of the component particles themselves. (P.C.H.)

30954 LOW-ENERGY ELECTRON-ATOM AND ELECTRON-MOLECULE SCATTERING THEORY. CIRCA 1964. E. Gerjuoy (Univ. of Pittsburgh). Phys. Today, 18: 24-6; 28-30(May 1965).

A survey of the more important recent developments in the theory of electron scattering at nonrelativistic energies is presented. (D.C.W.)

30955 DERIVATION OF MAXWELL'S EQUATIONS. THE ATOMIC FIELD EQUATIONS. S. R. De Groot (Instituut voor Theoretische Fysica, Amsterdam) and J. Vlieger. Physica, 31: 125-40(Feb. 1965).

From the electromagnetic equations for fields produced by point particles (electrons and nuclei), the field equations are derived in covariant form, taking into account the existence of stable atoms (or molecules, or ions). These atomic field equations involve, besides the field tensor (e,b) an atomic polarization tensor (p,m), or alternatively the field tensor (d,h) = (e + p, b − m). The atomic polarization tensor is given up to second order in the internal atomic variables as a function of atomic positions and velocities, proper electric dipole and quadrupole and magnetic dipole moments, and time derivatives of these quantities. The proper atomic multipole moments are defined in Lorentz frames in which the atoms are momentarily at rest. (auth)

30956 EXCITATION OF HELIUM BY He^+ AND POLARIZATION OF THE RESULTING RADIATION. F. J. De Heer and J. Van Den Bos (F.O.M.-Laboratoriuum voor Massascheiding, Amsterdam). Physica, 31: 365-84(Mar. 1965).

Absolute excitation cross sections were determined for He^+ incident on He by measuring the intensities of the singlet and triplet lines of the He I spectrum emitted by the target atom between 2900 and 6000 Å. The polarization of the photons was also measured. The impact energy was between 5 and 100 kev. As a function of the energy the cross sections show a similar behavior for different levels of a spectral series, and the polarization of light tends to be the same for the corresponding emission lines. Generally, more than one maximum is found in the cross section curves, and these maxima have a tendency to shift to higher impact energies for levels with increasing quantum number n, probably due to the corresponding increase of excitation energy. Moreover, the energies of the cross section maxima decrease with increasing azimuthal quantum number l, which may be explained by means of electrical polarization of the target atom. Cross section results are compared with the theoretical calculations of Moiseiwitsch and Stewart, using Born approximation. A big discrepancy is present, and it seems also probable that their neglect of the electron exchange process is in contradiction with the large experimental cross sections observed for excitation of triplet states. Comparing the results for He excitation by He^+, He^+ and H impact, it is found that levels with higher l values are relatively more excited if the effective charge of the impacting particle increases. This can be understood by taking into account electrical polarization of the He target atom by projectiles with a larger effective charge. (auth)

30957 A SEMI-EMPIRICAL FORMULA FOR CALCULATION OF ABSOLUTE CROSS SECTIONS FOR IONIZATION AND EXCITATION OF ATOMS BY ELECTRONS. L. Vriens (Universiteit, Utrecht). Physica, 31: 385-95(Mar. 1965).

A simple analytical expression for the absolute ionization and (optically allowed) excitation cross sections, as a function of the electron energy, is derived. In this expression there are two parameters. The first one is proportional to the optical oscillator strength, and the second one is dependent on the shape of the differential cross section (generalized oscillator strength), for scattering of energetic electrons as a function of their (small) momentum loss. The analytical expression is exact for large energies of the impinging electron. For small energies of this electron, the expression gives good agreement with experiment. Ionization cross sections are calculated for H, He, Ne, Ar, Kr, Xe, H_2, N_2 and O_2. Excitation cross sections are calculated for H and He. (auth)

30958 THE ANGULAR DISTRIBUTION OF ELECTRONS ELASTICALLY SCATTERED BY HELIUM ATOMS AND BY HYDROGEN MOLECULES. S. P. Khare and B. L. Moiseiwitsch (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 85: 821-39(May 1965).

The differential cross sections for the elastic scattering of electrons by helium atoms and by hydrogen molecules were calculated over a wide range of electron impact energies with allowance made for the contribution to the scattering from the static fields of the target systems, for the effect of electron exchange and, in the case of helium, for the polarization of the target atom by the Coulomb field of the incident electron. The approximate methods which were used include the Born approximation, the first-order exchange approximation and, in the case of helium, the numerical solution of the differential equations derived by making a partial-wave analysis and employing the static-field approximation, together with a polarization potential term, which behaves as $-\alpha/r^4$ for large radial distances r and vanishes as r approaches zero. In addition, use was made of the zero- and first-order phase shifts calculated by Morse and Allis from the exact numerical solutions of the appropriate exchange approximation integro-differential equations for the helium case. It is found that the agreement between theory and experiment is quite satisfactory provided the experimental data for the angular distribution of elastically scattered electrons are normalized separately from the calculated differential cross section curves for each energy of impact, though there remains a tendency for the very small and the large scattering angle data to lie somewhat above that predicted by the theory. However, if the normalization of the experimental data is carried out at just a single high energy of impact, the calculated curves are found to lie well above the experimental points at low electron energies over most of the range of scattering angles. The satisfactory accord obtained for molecular hydrogen between the experimental data and the differential cross sections calculated with polarization neglected suggests that in this case the effect of polarization may be small even though the polarizability of molecular hydrogen is considerably greater than that of helium for which its role is found to be important. (auth)

30959 PRODUCTION OF $H^-(1s^2)$ BY HYDROGEN ATOM COLLISIONS. R. A. Mapleton (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 85: 841-4(May 1965).

The prior and post Born matrix elements are used to calculate the cross sections for $H^-(1s^2)$ production in hydrogen atom collisions. In contrast to the original version of this work done by Mapleton in 1960, the plane-wave approximation to the Coulomb function is partially corrected. The

same H^- wave functions are used, and the post cross sections are substantially unaltered. Cross sections calculated with the improved H^- wave function as compared with the other H^- wave functions are from 20 to 35% larger for the prior case and 20 to 30% larger for the post case. The post-prior discrepancy, expressed as a ratio, varies between 0.001 and 0.33. (auth)

30960 RADIATIVE CHARGE TRANSFER FROM He ATOMS TO He^{2+} IONS. D. C. S. Allison (Royal Coll. of Advanced Tech., Salford, Eng.) and A. Dalgarno. Proc. Phys. Soc. (London), 85: 845-9(May 1965).

The rate coefficient for radiative charge transfer from He atoms to He^{2+} ions is calculated for temperatures up to 16,000°K. It is found to be a slowly increasing function of the temperature with a mean value of 4×10^{-15} cm^3 sec^{-1}. (auth)

30961 A SCREENING EFFECT IN ELECTRON-NUCLEAR SCATTERING. R. C. Dougal (Univ. of Edinburgh). Proc. Phys. Soc. (London), 85: 851-4(May 1965).

Measurements were made of the ratios of electron-nuclear scattering cross sections for scattering angles of 20, 30, 45, and 65° over the energy range from 100 to 400 kev. The results favor the corresponding screened theoretical cross section ratios rather than the unscreened ones. (auth)

30962 A MONTE CARLO CALCULATION ON THE SCATTERING OF ELECTRONS IN COPPER. H. E. Bishop (Cambridge Univ., Eng.). Proc. Phys. Soc. (London), 85: 855-66(May 1965).

The Monte Carlo method described by Green in 1963 was used to investigate the scattering of 29-kev electrons in a copper target. The results are compared with experimental data and are used to suggest how theoretical expressions obtained for an infinite solid may be modified to apply to the practical case of a semi-infinite target. (auth)

30963 HIGHER AUTOIONIZATION PROCESSES IN ARGON AND XENON. N. R. Daly (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 85: 897-907(May 1965).

Electron impact ionization of argon and xenon was studied. It was found that singly and doubly charged metastable ions are produced near the threshold energies for double and treble ionization respectively. These excited ions were found to decay by autoionization. Measurements were made of the excitation functions of these ions and in some instances the lifetime and production cross section. Argon was studied in most detail, but similar processes were found to occur in Ne and Kr although the results are not reported. (auth)

30964 IONIZATION IN HELIUM AT HIGH PRESSURES. J. Dutton, F. Llewellyn Jones, and D. B. Rees (University Coll. of Swansea, Wales). Proc. Phys. Soc. (London), 85: 909-20(May 1965).

An apparatus for the measurement of steady-state prebreakdown ionization currents in helium at high pressures is described, and the sampling procedure necessary to obtain with it reproducible results is discussed. The primary and secondary ionization coefficients determined from these measurements are given for $3.3 < E/p_0 < 5.0$ v cm^{-1} $mmHg^{-1}$ and for $150 < p_0 < 560$ mm of Hg. The values of α are discussed in relation to previous theoretically computed values and the experimental values obtained at lower gas pressures, but with similar values of E/p_0. The values of the generalized secondary ionization coefficient are found to be relatively high (~0.1) and to increase as E/p_0 decreases. (auth)

30965 THE STOPPING POWERS OF ATOMS AND MOLECULES. Y. M. Chan and A. Dalgarno (Queen's Univ., Belfast). Proc. Roy. Soc. (London), Ser. A, 285: 457-9(May 4, 1965).

A procedure is described for calculating the average excitation energy of an atom or molecule appropriate to the slowing down of a beam of charged particles in a gas. The procedure was applied to helium with the result that its average excitation energy is 42.0 ev. (auth)

30966 IONIZATION OF INNER ELECTRON SHELLS BY FAST ADIABATIC COLLISIONS OF HEAVY IONS. Hans J. Specht (Technische Hochschule, Munich). Z. Physik, 185: 301-30(1965). (In German)

Characteristic x rays produced in nearly adiabatic collisions when fission products of 5–80 Mev energy are stopped in various materials were studied using proportional counter detection. The cross sections for the ionization of inner electronic shells of both the colliding particles were measured as a function of the velocity and the mass of the fragments and the atomic number of the target atoms. The measured cross sections range from 10^{-22} to 10^{-16} cm^2. There is no agreement with the values predicted on the basis of a simple Born approximation description. Characteristic maxima were found in the dependence of the cross section on the atomic number of the projectile whenever the binding energy of the excited electron equals the electron binding energies of the various inner shells of the projectile. The cross sections depend less strongly on the velocity of the projectiles than predicted by the simple theory. The measured x-ray quanta have energies from 1.2 to 11.4 kev. The observed energy values exceed the theoretical ones by about 0.10 kev for projectile atomic numbers >10. A qualitative explanation of the various effects is presented. (auth)

30967 THE PRODUCTION OF RANGE-ENERGY RELATIONS OF IONS. L. Morbitzer and A. Scharmann (Universitat, Giessen, Ger.). Z. Physik, 185: 488-92 (1965). (In German).

Previous published penetration depth-energy-relations are represented in a reduced manner with different parameters by the theories of Lindhard and Scharff and of Holmes. The results are discussed. (auth)

Cosmic Radiation

See also Elementary Particles and Radiations. Nuclear Properties and Reactions.

30968 (BNL-9093) SOLAR NEUTRINOS. Raymond Davis Jr. and Don S. Harmer (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 16p. (CONF-641214-2). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Texas Symposium on Relativistic Astrophysics, Austin, Tex.

An experiment for observing the solar neutrino radiation based on the neutrino capture reaction $\nu + {}^{37}Cl \rightarrow {}^{37}Ar + e^-$, is discussed. The expected solar neutrino cross section in ^{37}Cl was calculated. A pilot experiment, to test the method, was performed with 1000 gal (6.1 tons) of perchloroethylene (C_2Cl_4), corresponding to an expected capture rate of 0.05 ± 0.03 per day. The experimental upper limit found on the capture rate is roughly five times as large as the calculated rate. Plans for a large-scale experiment, using 610 tons of perchloroethylene, are discussed, and the general experimental arrangement is described. (M.J.T.)

30969 (INSJ-83) AN ANALYSIS OF THE HIGH-ENERGY JET SHOWERS. PART III. T. Borello, M. Cattani, M. Cruz, S. Hasegawa, C. M. G. Lattes, E. Okuno, C. M. Orsini, I. Pacca, H. Sequeiros, and N. Yajima (Institute for Nuclear Study, Univ. of Tokyo (Japan)). Dec. 21, 1964. 59p. Dep.(mn).

Experimental data to be analyzed are described; about 100 jet showers of the type $N_h = 0$ and 1 are chosen by the elementary-process criterion. Results of total energy and angular momentum transferred to secondary mesons, mean energy of secondary mesons, and inelasticities in the ms and the cms are shown as functions of r_c, for incident energy range from $r_c \sim 5$ to ~400. Discussions are given of the two-fireball model, the excited baryon model,

and the multifireball or H-quanta hypothesis using the relations of physical quantities obtained. (M.J.T.)

30970 EXPLORER XI EXPERIMENT ON COSMIC GAMMA RAYS. W. Kraushaar, G. W. Clark, G. Garmire, H. Helmken, P. Higbie, and M. Agogino (Massachusetts Inst. of Tech., Cambridge). Astrophys. J., 141: 845-63 (Apr. 1, 1965).

A search for cosmic gamma rays in the energy range 100 Mev and greater with the satellite Explorer XI has given an apparent average intensity of about 3×10^{-4} cm^{-2} sec^{-1} sterad^{-1}. Internal evidence favors the identification of the particles which give rise to this intensity as cosmic gamma rays, but because a celestial anisotropy is not evident the measurement must be regarded as an upper limit on the true intensity. The apparent intensity is 10 to 20 times as large as predicted for π^0-decay gamma rays from cosmic-ray collisions with interstellar hydrogen, but can be accounted for if one assumes a modest intensity of high-energy electrons in intergalactic space. (auth)

30971 TRANSMISSION OF CHARGED PARTICLES THROUGH A KINK IN A MAGNETIC FIELD. Carl E. Rosenkilde (Univ. of Chicago). Astrophys. J., 141: 1105-16(Apr. 1, 1965).

Interest in the penetration of cosmic rays through a heliocentric blast wave propagating through the quiet-day interplanetary field led to consideration of charged-particle motion through an idealized kink formed when two semi-infinite regions, containing uniform magnetic fields in different directions, meet along a plane interface. Geometric criteria are used to obtain the transcendental curve in velocity space separating the reflected and transmitted particles. The simple cases, where the field on one side is normal to the interface, are solved analytically and then combined to yield a converging graphical method in the general case. This general method is illustrated for a possible blast-wave configuration by a series of phase diagrams which verify that, and indicate how, such an interface reflects particles. Some inequalities, comparing the constants of motion on each side of the interface, indicate that no permanent trapping occurs, although particles may recross the interface several times before finally escaping. (auth)

30972 NUCLEAR ABUNDANCES IN COSMIC RAYS. D. C. Peaslee (Australian National Univ., Canberra). Proc. Australian N. Z. Assoc. Advan. Sci., Canberra, 20-4(Jan. 1964).

An attempt is made to infer various features of cosmic ray origin and history from their nuclear abundances, namely: (1) The break in the spectrum at ~10^{16} ev corresponds to the changeover from intra- to extra-galactic sources. (2) Present intragalactic cosmic rays (IGCR) seem to represent an integral over sources throughout the lifetime of the galaxy. (3) The injection-acceleration mechanism for IGCR strongly favors heavy nuclei and may cut off entirely for nuclei lighter than C. (4) An appreciable abundance of deuterium can be predicted in IGCR; L ≤ D ≤ M. Detection may be technically difficult in the presence of 10^2–10^3 times as many H nuclei. (BBB)

Criticality Studies

See also REACTOR TECHNOLOGY — Criticality Studies.

30973 (HW-74640) NEUTRON MULTIPLICATION MONITOR. J. D. Lodge (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Aug. 21, 1962. Contract AT(45-1)-1350. 14p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

A neutron multiplication monitor to provide a continuous indication of how near a process vessel is to criticality by measuring the neutron leakage is described. The basis of the subcritical multiplication method using an artificial neutron source is explained. The monitoring system instrumentation, including a BF_3 detector, preamplifier, linear amplifier, count rate meter, and recorder, is described. Data obtained from monitoring solutions of $Pu(NO_3)_4$ and UO_2F_2 are presented. (M.J.T.)

30974 (HW-81460) TECHNICAL CRITERIA FOR THE PREVENTION OF CRITICALITY–CHEMICAL PROCESSING DEPARTMENT. W. S. Frank (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Apr. 8, 1964. Contract AT(45-1)-1350. 8p. Dep. (mn); $1.00(cy), 1(mn) CFSTI.

Criticality safety criteria used at the Hanford Chemical Processing Department are reviewed. The purpose of these criteria is the achievement of low risk of criticality at a cost that is considered reasonable relative to the risk involved. (T.F.H.)

Direct Energy Conversion

Refer also to abstract 31321.

30975 (AD-611403) RESEARCH STUDIES ON THERMIONIC CONVERTERS, EMITTER SHELL PHASE. Report No. 4. Fourth Quarterly Technical Report, April 1–December 15, 1964. G. Y. Eastman (Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dep.). Dec. 1964. Contract DA-36-039-AMC-03197(E). 43p. $2.00(CFSTI).

Eighteen converters were fabricated, 16 with double-walled emitter-shell geometry. After the solution of a number of fabrication problems, a converter was constructed which produced power output equivalent to electrically heated converters. This converter was successfully life tested for 1000 hours at an average emitter temperature of 1235°C. A second converter was life tested at an emitter temperature of 1320°C for 202 hours before failing. A converter was subjected to thermal cycling from −40°C to +1400°C in less than 5 minutes without failure in accordance with the contract requirements. Permeation testing was carried out on an aluminum oxide sample in a fossil-fuel environment. The principle permeating gas was shown to be oxygen. (auth)

30976 (CONF-641011-3) CHARACTERISTICS OF THE NEUTRALIZATION PLASMA IN THE ARC-MODE THERMIONIC CONVERTER. R. H. Bullis and W. J. Wiegand (United Aircraft Corp., East Hartford, Conn. Research Labs.). [1964]. 13p.

From Thermionic Conversion Specialist Conference, Cleveland.

Further detailed measurements of the properties of the non-equilibrium plasma existing in the interelectrode space of arc-mode converters have been made with coaxial electrostatic Langmuir probes. Previous probe measurements have detected the existence of a small retarding sheath in the immediate vicinity of the emitter as well as variation in the plasma potential which is accelerating for electrons and which extends over distances from the emitter surface corresponding to 20 to 30 percent of the interelectrode spacing. Detailed studies have been made to determine the behavior of the potential distribution for variations in emitter temperature, cesium pressure, converter spacing, and output. From these studies, the position of the minimum point in the potential well, which is accelerating for electrons, has been found to be strongly affected by changes in emitter temperature and cesium pressure. The overall potential drop in the electron accelerating region near the emitter appears to be independent of the energy required to excite a cesium atom from the ground state to the $6P_{\frac{1}{2}}$, $6P_{\frac{3}{2}}$ first excited states. The average fields found to exist in this region range from 300 to 1500 v/m. The small retarding sheath near the emitter surface has been found to be strongly influenced by the production rate of ions at the emitter surface. A strong correlation has been observed between several of the parameters of the plasma and the output characteristics of the arc-mode converter. The observed variations in electron number density and electron energy distribution with position in the interelectrode space

determined from probe measurements correlate well with spectroscopically determined electron densities and electron temperatures. (auth)

30977 (ECOM-2547) UNSYMMETRICAL WAVEFORM THERMIONIC DIODE AND SYSTEMS STUDY. Joseph P. Angello (Army Electronics Labs., Fort Monmouth, N. J.). Jan. 1965. 26p.

The operation of a pulsed, cesium-vapor thermionic diode is analyzed as an unsymmetrical waveform generator. The characteristics of the diode in this mode are investigated to determine the optimum duty cycle ratio of on-off time and to establish the requirements for the switching circuitry and power transformer. The system approach taken for raising the low voltage power of a diode to meet the impedance requirements of most equipment may have advantages over a system employing a large number of diodes connected electrically in series. (auth)

30978 (LA-DC-7073) THE LOS ALAMOS THERMIONIC CONVERSION PROGRAM AND RELATED WORK. A. W. Blackstock (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 14p. (CONF-650418-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From "BUILD" Conference on Direct Energy Conversion, Urbana, Ill.

A program of evaluation, fabrication, and testing of materials for nuclear-thermionic energy conversion devices is described. Experimental and theoretical studies of various cell designs and basic converter physics are also described. Both in-pile and out-of-pile testing of materials is discussed. (T.F.H.)

30979 THE PRESENT STATE OF DIRECT ENERGY CONVERSION. Joachim Euler (VARTA AG, Frankfurt am Main and Universitat, Giessen, Ger.). At. Strom., 11: 21-8(Mar. 1965). (In German)

The present state of direct energy conversion is discussed. Both the isotopic battery and thermoelements have been developed to a usable stage. Galvanic fuel cells are ready for development, although the technological difficulties are great. The thermionic converter is still not out of the research stage, although prototypes have operated satisfactorily for more than a thousand hours. The MHD generators are at the beginning of their development. The properties and functions of each of these are discussed. (J.S.R.)

30980 PERFORMANCE OF A SEGMENTED ELECTRODE MHD GENERATOR FOR VARIOUS ELECTRODE-INSULATOR LENGTH RATIOS. E. A. Witalis (Aktiebolaget Atomenergi, Studsvik, Nykoping, Sweden). J. Nucl. Energy, Pt. C, 7: 235-44(May-June 1965).

The increase of internal resistance caused by finite electrode size effects is calculated by means of conformal mapping in a fashion similar to that used by Hurwitz et al. but also taking into account the effect of varying the relative size electrodes and insulators. It is shown that the relation insulator length/electrode length = Hall angle/ninety degrees leads to a minimum of the generator internal resistance and a minimum of ohmic dissipation in the vicinity of the electrodes. The relation also gives the largest size which the electrode can attain before current starts to flow between adjacent electrodes. (auth)

30981 THERMODYNAMICAL ANALYSIS OF THE MHD POWER CONVERSION DEVICES. Rodolfo Monti (Universita, Naples). Missili, 5: 259-66(Sept.-Oct. 1963). (In Italian)

A thermodynamical analysis is made of the MHD power conversion devices with reference to d–c generators ($J \wedge B$ type) and the equations governing the conversion of kinetic energy into electrical energy are written for the general case of the skewed electrodes generator. The general efficiency and the performance parameters expressions are specified for the most usual cases of the electrical connections. (auth)

30982 THE THERMIONIC CONVERSION OF ENERGY. J.-E. Picquendar. Rev. Gen. Electron., No. 216, 19-25 (1964). (In French)

The principles of thermionic conversion are outlined. The design, operation, and performance of a test converter with a pure metal emitter are described. Converters with non-homogeneous emitters are considered. The use of solar radiation and nuclear energy in connection with thermionic converters is discussed. (J.S.R.)

30983 LE CONVERTISSEUR THERMO-ELECTRONIQUE (OU CONVERTISSUER A PLASMA). (The Thermoelectric Converter (or Plasma Converter)). N. D. Morgulis. Collection Espace et Electronique. Translated by G. de Faget. Paris, Gauthier-Villars, 1965. 92p.

A brief examination is given of the physical principles of the thermoelectric method for the direct transformation of thermal energy into electric energy. Thermoelectron and thermionic emission, space charge and its neutralization, general properties of thermoelectric converters, and some laboratory models and proposed designs of converters are considered. (J.S.R.)

30984 INVESTIGATION OF THE CURRENT DENSITY LIMITATIONS IN A THERMIONIC CONVERTER. TECHNICAL SUMMARY REPORT. C. Kaplan and J. B. Merzenich (Marquardt Corp., Van Nuys, Calif.). 22p. (CONF-641011-2)

From Thermionic Conversion Specialist Conference, Cleveland.

A large number of current-voltage curves were obtained, using pure Cs and also a Cs-Xe mixture. Comparison of the Cs-Xe data with the Cs data shows that the addition of 60 torr of Xe gas to the converter yielded an increase of from 15 to 80% in output power, for a fixed emitter temperature and a given output voltage. The maximum power output obtained with the Cs-Xe mixture was 8.3 w/cm^2 at an emitter temperature of T_e = 1370°C. The increase in power output appears to be due to a decrease in the internal voltage loss required for production of ions by volume ionization. A decrease in output was obtained when Ne was added to the converter. Pulsed-discharge experiments were also performed with pure Cs and with a Cs-Xe mixture. A high-current pulse was applied to the converter, followed by rapid switching to lower current levels. The pulsed current-voltage characteristic, obtained by measuring the current and voltage just after the pulse, indicates that the transport losses in the converter are eliminated by the excess positive ions produced during the pulse. The electron current just after the pulse is limited only by the work function barriers; this allows measurement of the collector work function under realistic diode operating conditions. The measured collector work function shows the variation with T_c/T_{Cs} (collector temperature/cesium reservoir temperature) measured by other techniques. The decay time of the increased voltage after the pulsed discharge is a measure of the ion lifetime. The data indicate that a two-stage decay process is occurring, which implies the presence of two types of positive ions, Cs^+ and Cs_2^+. The decay time of the faster ion, tentatively identified as Cs_2^+, is longer in Cs-Xe than in Cs. (auth)

30985 IMPROVEMENTS IN OR RELATING TO GASEOUS INSULATION FOR MAGNETOHYDRODYNAMIC ENERGY CONVERSION APPARATUS. (to Westinghouse Electric Corp.). British Patent 983,226. Feb. 10, 1965. Priority date July 17, 1962, United States.

An insulating gas layer is provided within the duct for flow of the working fluid in a MHD generator to protect the wall's members and to eliminate short circuits between the electrodes due to stagnant accumulation of working fluid. Cooling means for the wall members include a coolant nozzle disposed upstream of the electrodes to supply the layer of coolant gas. The wall members may be made of porous material or may have tubular members disposed within them to permit the coolant gas to flow through to form the blanket layer. (B.L.M.)

30986 THERMOELECTRIC GENERATOR. (to Minnesota Mining and Mfg. Co.). British Patent 985,430.

Mar. 10, 1965. Priority date June 14, 1960, United States.

A thermoelectric generator achieves relatively large power output by the use of a compact structure in which the heat flux through the thermoelements is maximized. In the generator a tube has one or more rings, which define an annular space between itself and the tube, surrounding the tube. A pair of thermoelements is located at one side of the tube, and at the other side is located a biasing means for pressing the ring radially away from the tube so that the elements are pressed between the ring and the tube. Each ring is of metal and is in electrical contact with the thermoelements so as to provide a thermojunction. A number of pairs of elements may be arranged along the length of the tube with a plurality of resilient rings and separate biasing means for each ring. A sealed casing filled with gaseous H_2 under pressure encloses the generator on the tube. The generator structure is adapted for operation in the hottest portion of the flame of a gas burner or other conditions of extreme heat, and the biasing means is heat insulated from the casing. (B.L.M.)

30987 A METHOD AND AN ARRANGEMENT FOR GENERATING THERMO-ELECTRICAL ENERGY. Carl Fabian Richert von Koch. British Patent 986,141. Mar. 17, 1965. Filed Jan. 12, 1962.

A method of converting heat energy into electrical energy is described in which the hot junction of a thermocouple is heated with heat pulses by intermittent supply of heat. The heat content and time sequence of the pulses are adjusted in accordance with the electrical power requirement in such a way that the quantity of heat energy supplied in each pulse has been substantially removed from the hot junction before the next pulse is supplied. If two or more such generators are connected in series and/or parallel and are heated with heat pulses staggered in time, either a direct current of low ripple or an alternating current of desired waveform is generated. The direct current may be immediately used for electrolysis, desalting or purification of water, or charging of storage batteries. If the alternating current is desired, it is possible to modify considerably the waveform or to generate a multiphase current. (B.L.M.)

30988 THE CONVERSION OF THERMAL ENERGY INTO ELECTRONIC ENERGY. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 987,464. Mar. 31, 1965. Priority date July 27, 1961, Germany.

Chemically reacting gases, oxygen and a fuel gas, are supplied to a heated chamber into which is supplied a finely divided substance having a metal content. The metal containing substance may be atomized with ultrasonic energy before its introduction into the burning gases in the chamber and is preferably a carbonate or chloride solution of Cs or K. At the outlet of the chamber is a Laval nozzle that forms the cathode of the converter on the surface of which the metal addition becomes ionized by contact ionization. The ions become discharged on baffles forming the anode of the converter and located further downstream. An envelope or casing of the converter consists of two electrically conductive parts separated by a cylinder of insulating material. Terminals connected to the two conductive parts lead away the d-c voltage produced in the converter. (B.L.M.)

30989 IMPROVEMENTS IN OR RELATING TO METHODS AND APPARATUS FOR CONVERTING MECHANICAL OR CHEMICAL ENERGY INTO ELECTRICAL ENERGY. Emerson Taylor Cannon, William Henry Clark, and William Schwabbel Partridge (to Interstate Engineering Corp.). British Patent 987,545. Mar. 31, 1965. Filed Nov. 23, 1963.

A method and apparatus are provided by which the stored energy contained in various forms of energy-bearing elements is made recoverable and convertable into electrical energy by using it to rapidly compress or collapse a magnetic field within which the released energy is stored. An electric current amplifier is operated and controlled from a rapidly released mechanical force in such a way as to be capable of increasing the current in the circuit, the intensity of the field generated by the current flowing in the circuit, and the magnetic flux in the field. A small flux produces a current flow in the conductor loop, and the loop is then rapidly and progressively shortened mechanically to concentrate the developed field into a smaller volume to deliver to a final collecting or energy directing means of a highly concentrated magnetic flux. The energy is recovered in usable form by any suitable type of coupling and supplied to a load circuit or directed into a utilization device. (B.L.M.)

30990 IMPROVEMENTS IN OR RELATING TO THERMO-ELECTRONIC CONVERTERS. (to CSF-Compagnie Generale de Telegraphie Sans Fil). British Patent 987,627. Mar. 31, 1965. Priority date Nov. 19, 1962, France.

A thermoelectric converter is described in which a photon flow of radiant energy is used to excite neutral atoms of the ionizable gas. The converter includes an electron emitter and an electron collector located within a vacuumtight enclosure filled with an ionizable gas or vapor such as Cs at relatively low pressure. The flow of light is admitted through at least one aperture; and once inside the enclosure, the flow of light is subjected to multiple reflections in order to obtain multiple transversals through the space occupied by the ionizable gas. Alternatively, the converter may have a transparent envelope surrounded by a system of mirrors into which a flow of light is introduced so as to undergo multiple reflections and transversals through the gas. (B.L.M.)

30991 THERMOELECTRIC COMPOSITIONS AND DEVICES. (to Radio Corp. of America). British Patent 987,914. Mar. 31, 1965. Priority date July 28, 1961, United States.

A thermoelectric device capable of directly converting heat into electric energy is described. The proposed N-type thermoelectric alloy capable of operating at temperatures to about 1000°K, is made up of 70 to 95 mole % PbTe and from 5 to 30 mole % SnTe with the addition of a mixture of Pb and $PbBr_2$. The preferred composition range for the mixture is 35 to 65 mole % Pb and 65 to 35 mole % $PbBr_2$, and the amount of the mixture added to the PbTe-SnTe alloy is preferably in the range of 0.2 to 2.4 wt % of the PbTe and SnTe. The device includes two thermoelements of thermoelectrically complementary material. The thermoelements are conductively joined to form a thermoelectric junction. At least one of the elements consists of the N-type thermoelectric alloy. (B.L.M.)

30992 PROCESS AND APPARATUS FOR CONVERTING THERMAL ENERGY INTO ELECTRIC ENERGY. Bernard Devin, Juan Eibenschutz, and Siegfried Klein (to Commissariat à l'Énergie Atomique). Canadian Patent 694,310. Sept. 15, 1964. Priority date June 13, 1961, France.

A simply constructed and relatively inexpensive apparatus with no moving parts is described for the conversion of thermal energy into electrical energy. The apparatus is particularly adaptable to the use of energy furnished by nuclear reactors both in the form of heat and ionizing radiations. A rapid and preferably supersonic jet of the vapor of a fluid is obtained between the first heated zone in which the mass of fluid in the condensed state is assembled and a second cooled zone by the use of a nozzle separating the two zones and by maintaining a high pressure difference between the two zones. The pressure difference is itself obtained by maintaining a suitable difference between the temperatures of the walls of the two zones. The ionizing jet traverses a plurality of electrodes that collect the charges transported by the jet and that are electrically connected to some type of apparatus for utilizing the electrical energy. If the fluid is not easily ionizable and the jet is not sufficiently hot, means are provided in the apparatus for putting the jet in communication with an auxiliary chamber that contains a mass of easily ionizable material. (B.L.M.)

Elementary Particles and Radiations

Refer also to abstracts 31213, 31225, and 31265.

30993 (AD-611362) DOUBLE HYPERFRAGMENTS AND RELATIVE PARITY OF Λ AND Σ HYPERONS. Syurei Iwao (Syracuse Univ., N. Y. Dept. of Physics). [1960]. Contract AF49(638)-801. 19p. (AFOSR-177). $1.00(CFSTI).

A method for the determination of the relative parity of lambda and sigma hyperons is proposed. The possible bound states of the double hyperfragments are predicted from parameters obtained previously. If lambda-lambda interaction is attractive in the singlet S state, lambda and sigma will have the same parity; otherwise they will have opposite parity. (auth)

30994 (BNL-8935) THE PRESENT STATUS OF VERY HIGH-ENERGY p-p, $\bar{p}$-p, $\pi^{\pm}$-p AND $K^{\pm}$-p SCATTERING. S. J. Lindenbaum (Brookhaven National Lab., Upton, N. Y.). [Jan. 22, 1965]. Contract [AT(30-2)-Gen-16]. 41p. (CONF-650106-3). Dep.(mn); $2.00(cy), 2(mn) CFSTI.

From Conference on Symmetry Principles at High Energy, Coral Gables, Fla.

The present experimental and theoretical status of high energy p-p, $\bar{p}$-p, $\pi^{\pm}$-p, and $K^{\pm}$-p scattering is reviewed. The problem of the asymptotic behavior at very high energies of the elastic scattering and total cross sections is discussed. A summary of small angle p-p scattering results are tabulated and experimental data are presented for the various interactions. (L.B.S.)

30995 (CALT-68-6) POLARIZATION OF Λ HYPERONS IN ASSOCIATED PHOTOPRODUCTION. D. E. Groom and J. H. Marshall (California Inst. of Tech., Pasadena). [1963]. Contract AT(04-3)-41. 6p. (CONF-550-94). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From The International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The polarization of the Λ hyperon perpendicular to the plane of production was measured for the reaction $\gamma + p \rightarrow K^+ + \Lambda$. Measurements were made at 90° in the cms using the CalTech synchrotron at photon energies of 1100, 1200, and 1300MEv. The parity nonconserving decay $\Lambda \rightarrow p + \pi^-$ was used as a polarization analyzer. A K^+ range telescope and proton Cherenkov-counter scintillator telescope were used as detectors. Preliminary results are given and compared with previous experiment. (M.J.T.)

30996 (CALT-68-8) TRIPLETS AND TRIALITY. Murray Gell-Mann (California Inst. of Tech., Pasadena). [nd]. Contract AT(04-3)-41. 8p. (CONF-550-95). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From The International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A discussion is given of whether or not triplets—or, in general, spinor representations of SU(3)—will show up among hadrons. The notion of spinor representation is defined. The hypothetical case that real hadrons exist with triality $\tau = \pm 1$, is considered, introducing a new conserved quantum number $n_t - n_{\bar{t}}$, which stands for the number of triplets minus the number of antitriplets. The cases for $n_t - n_{\bar{t}}$ equal to 1 and −1 are discussed. Situations are enumerated for the different possible modes of conservation of $n_t - n_{\bar{t}}$, and various Lagrangian field theory models corresponding to these situations are reviewed. (M.J.T.)

30997 (CALT-68-14) THE SYMMETRY BREAKING INTERACTION. Yuval Ne'eman (California Inst. of Tech., Pasadena). Oct. 1964. Contract AT(11-1)-68. 10p. (CONF-641004-12). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Physical Society, Chicago.

An interpretation of the bootstrap idea is introduced, regarding strongly interacting matter as one self-interacting system, with the particles as its states, and satisfying an equation in Casimir operators. In this picture, the particle symmetries are introduced a priori, rather than as a result of kinematics; hadron matter displays the dynamical symmetry of SU(3) or of the larger chiral symmetry as a result of the bootstrap mechanism, but only upon injection of information by the weaker interactions. The necessity of a fifth a priori current is discussed. The problem of octet dominance in the symmetry breaking hamiltonians is considered. A possible chiral symmetry is suggested to be $R(8) \times R(8)$. (M.J.T.)

30998 (CALT-68-31) BEYOND SU(3). Yuval Ne'eman (California Inst. of Tech., Pasadena). [1965]. Contract AT(11-1)-68. 39p. (CONF-650106-6). Dep.(mn); $2.00(cy), 1(mn) CFSTI.

From Conference on Symmetry Principles at High Energy, Coral Gables, Fla.

Developments on symmetry principles are reviewed and summarized. SU(3) assignments are discussed in the light of the experimental situation. Transformation properties of the various asymmetries in SU(3) are reviewed; progress was made using bootstrap methods, and a unified picture of octet enhancement was offered. Suggestions with regard to a protosymmetry larger than SU(3) and still parity retaining—e.g., SU(4), Sp(6), and R(8)—are mentioned. Comments are given on the CP breakdown problem. Chiral symmetries where the endosymmetry is extended to include parity, Wigner type and mixed symmetries, spin extensions of SU(3)—e.g., SU(6), and Lorentz extensions of SU(3) and Dirac-completions of these schemes are discussed. Ideas with respect to the role of noncompact groups and connections with the bootstrap philosophy are considered. 130 references. (M.J.T.)

30999 (CALT-68-32) ROLE OF NON-COMPACT GROUPS. Yuval Ne'eman (California Inst. of Tech., Pasadena). [1965]. Contract AT(11-1)-68. 5p. (CONF-650106-8). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Conference on Symmetry Principles at High Energy, Coral Gables, Fla.

The use of noncompact groups by Gell-Mann in connection with orbital angular momentum in $U(6) \times U(6)$ is sketched; the algebraic origin of Regge recurrences of the ground-state baryons is traced to effects of the gravitational quadrupole moments, and equations containing the noncompact groups—having no unitary finite-dimensional representation, except for the one-dimensional—are developed. One application of noncompact groups, centering upon the band obtained from the bootstrap by adding a meson every time, is discussed. Speculation is presented on a related point, the attempt at a symmetry-equivalent to the bootstrap idea that no hadron is elementary. (M.J.T.)

31000 (CONF-550-93) PHOTOPRODUCTION OF NEUTRAL PIONS IN HYDROGEN AND DEUTERIUM. C. R. Clinesmith, G. L. Hatch, and A. V. Tollestrup (California Inst. of Tech., Pasadena). [1963]. Contract [AT(04-3)-41]. 12p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Measurements were made in the forward hemisphere of the photoproduction cross sections of neutral pions in H and D, using a 1150-Mev bremsstrahlung beam. The photons from the pion decay were detected by two total absorption Cherenkov counters, backed by scintillation counters in anticoincidence to eliminate charged particles. Pion angular distributions at 10° intervals from 0 to 90° in the cms are reported and compared with previous experimental results. The ratio of the D and H cross sections as a function of angle is given. (M.J.T.)

31001 (CONF-550-96) MANY-CHANNEL RESONANCE THEORY. Marc Ross (Michigan Univ., Ann Arbor and Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT(11-1)-1112. 5p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A simple representation of the partial wave amplitude for many-coupled two-body channels is discussed. An attempt is made to obtain a simple theory of the effects of many channels and their thresholds by representing the

right hand cuts explicitly and exactly, while drastically approximating the left-hand singularities. Expressions are obtained for the unitary scattering matrix for various approximations; scattering lengths are extracted, using Clebsch-Gordan coefficients, and compared with experiment, for the s-wave, $\frac{1}{2}^-$ meson-baryon state in pure SU(3) symmetry. (M.J.T.)

31002 (CONF-550-97) PERIPHERAL MODEL FOR ρ AND $\rho\pi$ PRODUCTION. Marc Ross (Michigan Univ., Ann Arbor). [1964]. Contract AT(11-1)-1112. 6p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The one-pion-exchange cross section for the reaction $\pi + N \rightarrow \rho + N$ was calculated, taking into account modifications due to initial and final state absorption; the energy dependence of the form factor is discussed. A study on kinematical peaks occurring in mass distributions in multiperipheral reactions is reviewed, for calculations on the reaction $\pi + N \rightarrow \rho + \pi + N$. (M.J.T.)

31003 (COO-881-43) DECAYS OF THE η MESON. M. Foster, M. Peters, R. Hartung, R. Matsen, D. Reeder, M. Good (Wisconsin Univ., Madison. Physics Dept.); M. Meer, F. Loefler, and R. MacIlwain (Purdue Univ., Lafayette, Ind.). Dec. 1964. Contract AT(11-1)-881. 17p. (CONF-641021-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From National Academy of Sciences, Autum Meeting, Madison, Wis.

The reaction $\pi^+ + p \rightarrow \pi^+ + p + \eta$ at 1225 and 1275 Mev/c was used to produce the η mesons; the decays $\eta \rightarrow \pi^+\pi^-\pi^0$ and $\eta \rightarrow \pi^+\pi^-\gamma$ were studied by analysis of all 4-prong events. Results of a maximum likelihood fit to determine the branching ratios $\Gamma_\eta\ (\gamma\gamma)/\Gamma_\eta\ (+-0)$ and $\Gamma_\eta(000)/\Gamma_\eta(+-0)$ are given. Attempts are made to fit various theoretical forms for the decay amplitude and branching ratios using the experimental data. (M.J.T.)

31004 (CU-1932-240) THE ONE-PION EXCHANGE MODEL AND AN ATTEMPT TO MEASURE THE SPIN OF THE f^0. N. Gelfand and G. Luetjens (Nevis Labs., Columbia Univ., Irvington-on-Hudson, N. Y.). May 1965. Contract AT(30-1)-1932. 17p. (NEVIS-134). Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

The unadorned one-pion-exchange model seems inadequate to explain the alignment of the ρ^0 and f^0 mesons. Because of this, the fits to the decay angular distributions do not give a clear indication of the spin of the f^0. Though it is extremely tempting to associate the appearance of a large μ^4 term in the fit to the angular distribution at the f^0 mass with a J = 2 resonance, the justification for doing so is not clear. The fact that the μ^4 term does not decrease until well past the f^0 peak is one sign that this might be a dangerous procedure. It is believed that the spin of the f^0 remains to be measured. (auth)

31005 (IC/65/45) TWO TYPES OF BARYONS IN BROKEN $(SU_3)_L \otimes (SU_3)_R$ SYMMETRY. Fayyazuddin, M. A. Rashid, and Riazuddin (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 1965. 5p. Dep.(mn).

It is shown that it is possible to get F-type vector and both F- and D-type axial vector currents such that $G_A^D + G_A^F = G_V$ and $G_A^F/G_A^D = 1$ in the $(SU_3)_L \otimes (SU_3)_R$ symmetry limit, provided the baryons do not belong to pure (8,1) and (1,8) or (3,3*) and (3*,3) representations, but to both of them. The implications of this assumption for the masses of the baryon octet and the Y_1^* are examined when this symmetry is broken. Two spin-$\frac{1}{2}$ baryon ocetets of opposite parities and a singlet with the same parity as one of the octets are obtained; their masses are given. (M.J.T.)

31006 (IC/65/46) ON THE MASS FORMULA FOR SU(6). M. A. Rashid (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 1965. 10p. Dep.(mn).

Attempts by Kuo and Yao and by Beg and Shingh to write the SU(6) mass formula corresponding to the Gell-Mann-Okubo formula for SU(3) multiplets are reviewed. Clebsch-Gordan coefficients for the group SU(6) are used to write down equations for the masses of the particles for the 35 and 56 representations in terms of the reduced matrix elements; cases of baryons and of mesons with linear and quadratic masses are considered. Various mass formulas are derived, in fair agreement with experiment; it is found that the existence of a bad relation does not necessarily imply a large reduced matrix element, and that large reduced matrix elements do not necessarily mean bad relations. It is concluded that, if the masses of the particles in the 35- and 56-dimensional representations are a guide for a mass relation, and if the mass operator is assumed approximately the same for both these cases, the only choice is to use linear relations for both and to consider contributions of only 1, 35, 189, and 405. (M.J.T.)

31007 (IC/65/50) NUCLEON-NUCLEON SCATTERING IN $\tilde{U}(12)$. D. A. Akyeampong, R. Delbourgo, and Fayyazuddin (International Centre for Theoretical Physics, Trieste (Italy)). May 4, 1965. 8p. Dep.(mn).

Baryon-baryon scattering is considered in the context of $\tilde{U}(12)$; studies were limited to the (equal mass) case of nucleon-nucleon scattering because of the computational difficulties in the relativistic problem. It was found that singlet and triplet scattering lengths are equal for the np system, the process $p\bar{p} \rightarrow p\bar{p}$ dominates near threshold over all other scattering involving baryons, and the polarization of outgoing nucleons is not ruled out by $\tilde{U}(12)$. The $B\bar{B}$ scattering amplitudes are derived in $\tilde{U}(12)$ and expressed in the G.G.M.W. form. (M.J.T.)

31008 (LA-3171) EXPERIMENTS ON THE REACTION $\pi + N \rightarrow \pi + \pi + N$ AT THE PROPOSED LOS ALAMOS MESON PHYSICS FACILITY. Lewis Agnew (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Sept. 1, 1964. Contract W-7405-eng-36. 27p. Dep.; $2.00(cy), 1(mn) CFSTI.

A survey of experimental work on the $\pi + N \rightarrow \pi + \pi + N$ reaction at incident pion energies below 1 Bev is reported. The feasibility of using a bubble chamber to study this reaction at LAMPF is discussed, including the experimental layout, the composition of the target, beam, and bubble chamber, data collection and analysis, and necessary quantity and precision of data. Possible experiments using electronic counters are considered in comparison with a previously performed analogous experiment; cross sections and analyzing powers for measuring the distribution and polarization of the recoil proton are discussed. (M.J.T.)

31009 (NP-15021) LECTURES ON FERMI DYNAMICS. MatScience Report 37. A. Fujii (Institute of Mathematical Sciences, Madras (India)). Notes by T. S. Santhanam. [1964]. 40p. Dep.(mn).

The strong, electromagnetic, and weak interactions are reviewed. Kinematics of beta decay of neutrons, muon decay and capture, and elastic lepton production are discussed. Fermi dynamics are considered, with discussions of reflections, the CPT theorem and CP invariance, quadrilinear fermion interaction, the helicity experiment, the V-A law, and muon and pion decay. Nucleon form factors are studied, describing nucleon current, the hypotheses of conserved vector current and asymptotically conserved axial vector current, and muon capture in hydrogen. (M.J.T.)

31010 (NPA/Int.63/11) NEUTRINO FLUX CALCULATIONS. S. van der Meer and K. M. Vahlbruch (European Organization for Nuclear Research, Geneva (Switzerland)). May 6, 1963. 31p. Dep.(mn).

A description is given of the method used for calculating the neutrino flux at the detectors, taking into account the focusing provided by the neutrino horn. Results of the computations for various experimental conditions are presented. (auth)

31011 (TID-21784) A PROGRAM TO CALCULATE 3-BODY DISTRIBUTIONS FOR A GENERAL MATRIX ELEMENT. Technical Report No. 442. G. B. Yodh (Maryland Univ., College Park. Dept. of Physics and Astronomy). Feb. 1965. Contract [AT(30-1)-2464]. 47p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The three-body Lorentz-invariant matrix element is calculated, taking into account the effects of interference, angular momentum barrier terms, decay characteristics, and partial waves dominating the process. An IBM 7094 Fortran program is outlined whose purpose is to carry out the numerical calculations involved in this study. (T.F.H.)

31012 (TID-21806) A MEASUREMENT OF THE BRANCHING RATIO FOR PION-BETA DECAY: R = $(\pi^+ \rightarrow \pi^0 + e^+ + \nu_e)/(\pi^+ \rightarrow \mu^+ + \nu_\mu)$ (thesis). William Keith Bertram (Michigan Univ., Ann Arbor). [1964]. Contract AT(11-1)-1112. 57p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

The pion beam is discussed, including beam optics and determination of electron and muon contamination. The detection system is described in detail, considering the scintillator-spark chamber gamma detectors, the beam counter telescope and spark chamber to record the stopping pion, the optical system for viewing and photographing the spark chambers, and the fast electronics and oscilloscope with camera to record the timing between the stopping pion and the gamma pulses from the π^0 decay. About 40,000 pictures were taken during two experimental runs. The processes used for data scanning and reconstruction, correcting for detection efficiency, gate efficiency, effective number of stopping pions, and scanning efficiency, and background subtraction are described. The branching ratio, calculated using 35 ± 3 events, was found to be $(1.10 \pm 0.26) \times 10^{-8}$, in agreement with the CVC and Cabibbo predictions and with other experimental results. (M.J.T.)

31013 (UCID-1165(Rev.)) DATA ANALYSIS FOR ASSOCIATED PRODUCTION EXPERIMENT. M. Alston and H. Monteros (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 29, 1960, Revised May 1, 1961. Contract [W-7405-eng-48]. 29p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

An experiment is planned to investigate the production and subsequent interactions of the particles produced in the π^- + p reaction; production reactions considered are π^- + p → $K^0 + \Lambda$, $K^0 + \Sigma^0$, $K^+ + \Sigma^-$, and $\pi^- + \pi^0$ + p. Pion beam momenta of 800 to 1600 Mev/c will be used. Possible interactions of the strange particles produced in the above reactions are considered, and criteria for their identification and analysis are discussed, including kinematics of production and decays and sketching of various event types. (M.J.T.)

31014 (UCRL-7942) DETERMINATION OF THE NUCLEON-NUCLEON ELASTIC SCATTERING MATRIX. II. PHASE-SHIFT ANALYSES OF EXPERIMENTS NEAR 50, 95, 142, 210, AND 310 Mev. Malcolm M. MacGregor, Richard A. Arndt, and David S. Bailey (Lawrence Radiation Lab., Univ. of California, Livermore). June 29, 1964. Contract W-7405-eng-48. 63p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Phase shift analyses have been carried out for (p,p) and (n,p) experiments at energies near 50, 95, 210, and 310 Mev. Both (p,p) data analyses and combined (p,p) plus (n,p) data analyses were obtained at these energies. Attention was concentrated in all cases on the Stapp type 1 solution, with the objective being to obtain the best possible values for the phase shifts from the existing nucleon-nucleon data. Error matrices were calculated for all solutions, and determinations of the pion-nucleon coupling constant g^2 were carried out. It was found that reasonably consistent values for g^2 can be obtained if a suitable selection of the phenomenological phase shifts is made. The T = 1 phase shifts determined from (p,p) data only were found to be in good agreement with the T = 1 phase shifts obtained from combined (p,p) plus (n,p) data, thus verifying the gross features of charge independence. For completeness, phase shift values at 142 Mev are included. (auth)

31015 (UCRL-11881) RECOIL-PROTON POLARIZATION IN NEGATIVE KAON-PROTON ELASTIC SCATTERING BETWEEN 700 AND 1400 Mev/c INCIDENT KAON MOMENTA (thesis). Ching Lin Wang (Lawrence Radiation Lab., Univ. of California, Berkeley). Apr. 19, 1965. Contract W-7405-eng-48. 84p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

A negative kaon beam from an internal target of the Bevatron was directed onto a liquid hydrogen target, and the polarization of recoil protons in K^--p elastic scattering was measured at 812, 952, 1050, 1159, and 1266 Mev/c incident kaon momenta. A scintillation and Cherenkov counter system identified K^--p interactions and triggered a spark chamber array and camera. A cylindrical spark chamber surrounding the hydrogen target was used to identify the elastic scatterings, and a semicylindrical chamber interleaved with carbon and steel absorbers was used to obtain the range and polarization information. The azimuthal asymmetry of the angular distribution of recoil protons which scattered in the carbon plates was observed, and the polarization was estimated by the method of maximum likelihood. By incorporating the K^--p elastic differential cross sections available from this and other experiments with the polarization obtained here, single-energy phase-shift analyses were made at 21 momenta between 620 and 1350 Mev/c. Furthermore, an energy-dependent phase-shift analysis was made by utilizing all available data on K^--p total cross section, differential cross section, charge-exchange cross section, and the K^--n total cross section between 110 and 1400 Mev/c. Both the results of single-energy and energy-dependent phase-shift analyses are in agreement with the suggestions of an F_5 resonance for the 1815-Mev bump in the K^--p total cross section; however, a D_5 assignment can fit the data equally well. A D_5 assignment is less favorable, yet it cannot be strongly ruled out. A possible set of energy-dependent phase-shift solutions was obtained by assuming a D_5 (T = 1) resonance at 1765 Mev and an F_5 (T = 0) resonance at 1815 Mev. This set is not unique. (auth)

31016 (UCRL-16115) A STUDY OF REGGE DYNAMICS IN PION-NUCLEON SCATTERING (thesis). John D. Stack (Lawrence Radiation Lab., Univ. of California, Berkeley). Apr. 27, 1965. Contract W-7405-eng-48. 92p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

A theoretical study is made of the MacDowell symmetry and the properties of fermion Regge poles. Subsequent to this, a set of Reggeized bootstrap equations for πN scattering is derived and analyzed. A careful discussion of kinematics is given, the inhomogeneous terms in the integral equation are constructed in detail, and the integral equation is transformed to one of standard Fredholm type. (auth)

31017 UNITARY SYMMETRY AND $\Delta T = \frac{1}{2}$ RULE. W. Krolikowski (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw and Warsaw Univ.). Acta Phys. Polon., 27: 355-7(Feb. 1965).

A transformation is defined under which the SU_3 invariant strong interactions create effective weak interactions obeying the $\Delta T = \frac{1}{2}$ rule in the first order. The assignment of pure P and S waves for the decays $\Sigma^+ \rightarrow n + \pi^+$ and $\Sigma^- \rightarrow n + \pi^-$ is considered. (D.C.W.)

31018 ELECTROMAGNETIC PROPERTIES OF ELEMENTARY PARTICLES IN THE G_2-SYMMETRY MODEL. Edvard Kapustsik (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Physiol. Polon., 27: 497-514(Mar. 1965). (In Russian)

A general method for investigating the electromagnetic properties of elementary particles in the G_2 symmetry model is proposed. The results obtained show that this model can not be used as a model of higher symmetry. (tr-auth)

31019 THE NATURE OF LIGHT. PART II. THE RELATIONSHIP BETWEEN PHOTONS, ELECTRONS AND POSITRONS. J. W. Robinson (Louisiana State Univ., Baton Rouge, La.). Anal. Chim. Acta, 32: 477-84(May 1965).

It is proposed that a photon is composed of a positive and a negative charge. The relationship between photons, electrons, and positrons is discussed. A mechanism for the production of coherent light by lasers is also proposed. The nature of light is intimately concerned with the special case of the theory of relativity. However the model proposed provides no clue to explain why this theory should hold. (auth)

31020 PERMUTATION SYMMETRY AND A DERIVATION OF UNITARY SYMMETRY. J. Schechter, Y. Ueda, and S. Ukubo (Univ. of Rochester, N. Y.). Ann. Phys. (N. Y.), 32: 424-43(May 1965).

Assuming the existence of three basic fields ϕ_1, ϕ_2, ϕ_3 with their linear combinations ψ_1, ψ_2, ψ_3 given by $\psi_\mu = \sum_{\nu=1}^{3} a_\mu^\nu \cdot \phi_\nu$ for some a_μ^ν, a proof of following is given: the total Hamiltonian, H is invariant under the three dimensional unitary group U(3) if H is invariant under permutations of ϕ_1, ϕ_2, ϕ_3 and if H preserves the particle numbers associated with the ψ_μ-fields (μ = 1, 2, 3). This holds in general except for a very special form of a_μ^ν in which case a broken U(3) symmetry is obtained instead. (auth)

31021 THE CALCULATION OF THE MASS DIFFERENCE OF SOME ELEMENTARY PARTICLES. Mario Rota and Gleb Wataghin. Atti Accad. Nazl. Lincei, Rend., Classe Sci. Fis., Mat. Nat., [361] 36: 581-6(May 1964). (In Italian)

Two problems of self-energy are studied, beginning with the Wataghin non-local theory which permits the calculation of the mass difference attributable to interactions. The first is the case of the pseudoscalar neutral pion and the second is the calculation of the mass difference between a charged $\pi^\pm$ and a neutral π^0. It is concluded that it is necessary to assign to the non-renormalized mass of the pion between 1.5 and 3 proton mass units. The contribution of the electromagnetic interaction to the self-mass of the charged pion is of the same order of magnitude as the mass difference observed. (J.S.R.)

31022 ENERGY LOSS OF ULTRARELATIVISTIC MUONS. II. PRODUCTION OF PAIRS. Carlo Castagnoli, Angelo De Marco, and Renato Scrimaglio (Universita, Turin). Atti Accad. Nazl. Lincei, Rend., Classe Sci. Fis., Mat. Nat., [361] 36: 639-45(May 1964). (In Italian)

The energy loss $(\underline{d}E/\underline{d}x)_k$ of ultrarelativistic muons caused by the production of pairs is calculated. A comparison is made between the data on which the Murota formula is based and that deduced with the formulas of other authors. (J.S.R.)

31023 ELASTIC SCATTERING AT VERY HIGH ENERGY IN THE FRAMEWORK OF THE STATISTICAL MODEL. J. Vandermeulen (Universite, Liege). Bull. Soc. Roy. Sci. Liege, 34: 34-41(1965).

By means of the covariant formulation of the statistical model for production of elementary particles, it is shown, by neglecting the rest masses, that the ratio of elastic scattering in the total cross section decreases as exp $[-E^\alpha]$ at very high energy, where α is equal to 1 or 0.67, depending on whether the particles produced are assumed to be distinguishable or not. In the first case, the law found agrees closely with the extrapolation of an expression found by Fast and Hagedorn to account for numerical calculations at moderate energies; the latter author has shown that using this expression provides an excellent interpretation of large-angle proton-proton elastic scattering in the 10 to 30 Bev incident energy region. (auth)

31024 SYMMETRY GROUPS IN H(R_3^4) SPACE. Pierre Hillion (Institut Henri Poincare, Paris). Cahiers Phys., 18: 361-8(Aug.-Sept. 1964). (In French)

The symmetry groups in H(R_3^4) are defined, and they are used in the theory of interactions when this H(R_3^4) is considered as isospace. (tr-auth)

31025 TORONTO ENTERS FIELD "TOO COSTLY" FOR CANADIAN UNIVERSITIES. J. D. Prentice and N. R. Steenberg (Univ. of Toronto). Can. Nucl. Technol., 4: No. 2, 53-5(1965).

A new research project for the University of Toronto Physics Dept. is a co-operative program in high-energy physics with Argonne National Laboratory and the University of Wisconsin. Negative pions from the 12.5-Bev Zero Gradient synchrotron were photographed in a liquid hydrogen bubble chamber. The interactions of elementary particles in some of the 200,000 pictures are being analyzed with computer assistance by the U of T workers. (F.S.A.)

31026 ISOSCALAR TENSOR OPERATORS OF THE SU_3 GROUP AND THE MASS RELATIONS BETWEEN PARTICLES IN AN OCTET MODEL. M. B. Menskii. Dokl. Akad. Nauk SSSR, 160: 64-7(Jan. 1, 1965). (In Russian)

Irreducible tensor operators are useful in studying the mass spectrum in any symmetrical model of elementary particles. The relations between matrix elements are obtained directly in explicit form by the use of a special form of tensor-operator which appears in the SU_3 model of strong interactions. The necessary and sufficient conditions for finding the matrix elements of a tensor-operator are set forth in the form of a theorem. The tensor-operators are used to find the mass particle spectrum in the octet model of strong interactions. If mixing of the unitary multiplets does not take place, the mass operator M does not have intersecting matrix elements, and the diagonal elements are equal to the masses of the corresponding particles. In this case it is possible to obtain the relations between the particle masses directly. (TTT)

31027 ANALYTIC CONTINUATION WITH THE BONDING CONSTANT IN THE CHEW-LOW EQUATION. V. A. Pazdzerskii (Tashkent State Univ.). Izv.Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 4, 94-5(1964). (In Russian)

The approximation of the dispersion relations together with unitarity conditions can be used for finding the limits for the bonding constant g^2. By this, it is seen that for g^2 greater than some significant $g^2_{critical}$, the solution for the dispersion amplitude satisfies a modified dispersion relation with additional polar terms (corresponding in appearance to a bound state). The Chew-Low equation is presented. Its dispersion relations with g^2 greater than $g^2_{critical}$ are obtained from initial dispersion relations (with g^2 less than $g^2_{critical}$) by means of analytic continuation with the bonding constant. The method used can be easily adapted for application to other interaction models. (TTT)

31028 NATURAL SYSTEM OF UNITS IN THE PHYSICS OF ELEMENTARY PARTICLES. B. I. Rusak (Tashkent State Pedagogical Inst.). Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 5, 76-8(1964). (In Russian)

The systematics of elementary particles make it possible to discuss the question of a natural system of units (ECE). This system is related to three systems of units used in theoretical work: the meh system which is preferred for describing atomic phenomena, the mce system for nuclear, and the mch system. The latter system appears to be most closely related to ECE. In the ECE system, the interaction of elementary particles can be described in terms of three dimensionless quantities. The corresponding relations are developed for a variety of cases. In addition, the description is broadened to include the interaction of particles with force fields. (TTT)

31029 THE INFLUENCE OF MAGNETIC FIELDS ON THE POSITRONIUM ENERGY SPECTRUM. M. Kraev. Izv. Fiz. Inst. s Aneb, Bulgar. Akad. Nauk., 10: 75-82 (1962). (In Bulgarian)

The energy spectrum of positronium in a weak constant homogeneous magnetic field is determined. The formulas describing the spectrum are derived. (tr-auth)

31030 SURFACE WAVE TRANSIENT RADIATION OF A CHARGED PARTICLE. V. Ya. Eydman (Gor'kii State Univ., USSR). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 188-90(1965). (In Russian)

The emission of a surface wave by a charge passing through the interface between a vacuum and a medium with a substantial dielectric constant is examined. An expression is obtained for the electric field in the surface wave, using the equation for the electric field component parallel to the trajectory of a particle in the medium. The energy losses of the charge due to emission of the surface wave are found by determining the energy flux transferred by the surface wave through the lateral surface of a circular cylinder with axis along the trajectory of the particle, employing the expressions for the electric and magnetic fields

in the wave. The cases of relativistic and nonrelativistic velocity are considered. (M.J.T.)

31031 THE RADIATION OF A BEAM MOVING ABOVE DIFFRACTION GRATING PLACED ON A SHIELDED DIELECTRIC. E. I. Chernyakov (Khar'kov Inst. of Mechanical Engineering, Automation, and Computer Techniques, USSR). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 193-5(1965). (In Russian)

A solution is given for the problem of the emission of electromagnetic oscillations by a monochromatic electron beam during its passage over a diffraction grating placed on a shielded dielectric. Equations for the electric and magnetic fields in the region over the grating and in the region filled with dielectric are obtained. The power able to be radiated in the regions is determined using the Pointing vector. In the region over the grating the radiation represents a superposition of dense waves coming from the grating, and in the region filled with dielectric it is analogous to the system of waves propagated between two parallel planes with dielectric filling. (M.J.T.)

31032 LOW-ENERGY ELECTRON-ELECTRON BREMSSTRAHLUNG. R. C. Stabler (Radio Corp. of America, Princeton, N. J.). Nature, 206: 922-3(May 29, 1965).

Discrepancies in the radiation emitted in electron-electron collisions at low energy are pointed out. Interest stems from the possible relevance of electron-electron bremsstrahlung to practical problems and also from its possible relevance to the radiative reaction problem. The target electron is considered to be free throughout the discussion. (P.C.H.)

31033 PROTON-PROTON DIFFRACTION SCATTERING. P. Smrz (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 63: 76-8(Mar. 1965).

On the basis of the one-pion-exchange model, the proton-proton diffraction peak is calculated, assuming a constant pion-proton diffraction peak in the asymptotic region. It is shown that the shrinking of the proton-proton diffraction peak can be explained also in terms of this model. (auth)

31034 THE ANOMALOUS MAGNETIC MOMENT OF THE MUON. G. Charpak, F. J. M. Farley, R. L. Garwin, T. Muller, J. C. Sens, and A. Zichichi (CERN, Geneva). Nuovo Cimento (10), 37: 1241-1363(June 16, 1965).

The anomalous part of the gyromagnetic ratio, $a \equiv \frac{1}{2}(g-2)$ of the muon was measured by determining the precession $\theta = a\omega_0\overline{B}t$ for 100-Mev/c muons as a function of storage time t in a known static magnetic field of the form $B = B_0(1 + ay + by^2 + cy^3 + dy^4)$. The result is $a_{exp} = (1162 \pm 5) \times 10^{-6}$ compared with the theoretical value $a_{th} = \alpha/2\pi + 0.76\ \alpha^2/\pi^2 = 1165 \times 10^{-6}$. This agreement shows that the muon obeys standard quantum electrodynamics down to distances ~0.1 fermi. Details are given of the methods used to store muons for $\sim 10^3$ turns in the field, and of measuring techniques and precautions necessary to achieve the final accuracy. Some of the methods of orbit analysis, magnet construction shimming and measurement, polarization analysis, and digital timing electronics may be of more general interest. (auth)

31035 THE ANNIHILATION OF ANTIPROTONS ON PROTONS AND NEUTRONS. A. J. Apostolakis, G. A. Briggs, N. A. Khan, and J. V. Major (Univ. of Durham, Eng.). Nuovo Cimento (10), 37: 1364-75(June 16, 1965).

Annihilations of antiprotons at rest in the nuclei of nuclear emulsion were separated into those in the light and those in the heavy elements. In the former it is possible to identify with certainty the annihilations on protons or on neutrons, and it is found that the ratio of the probabilities of annihilation on these is (0.97 ± 0.05). This implies that the annihilation proceeds equally through the singlet and triplet isospin channels. The apparent lack of equality of the probabilities of annihilation on protons and neutrons found in heavy elements is accounted for by the interactions of the annihilation products in the parent nuclei. (auth)

31036 PHYSICAL OPERATORS AND THE REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP. D. J. Candlin (Univ. of Edinburgh). Nuovo Cimento (10), 37: 1396-1406(June 16, 1965).

The classification of the physical (positive energy) representations of the inhomogeneous Lorentz group is presented in terms of the Lie algebra (in quantum terms, the physical observables). Canonical conjugates to the momenta can always be defined, but only for positive mass representations can they be interpreted as center-of-momentum co-ordinates. Space and time inversion are discussed. The principal new results are an understanding of the structure of the representations with zero mass and multiple helicity ("infinite spin"), and a clarification of the operation of time reversal for all physical representations. (auth)

31037 UNITARITY AND THE EVALUATION OF DISCONTINUITIES. [PART] III. D. I. Olive (Churchill Coll. and Dept. of Applied Mathematics and Theoretical Physics, Cambridge, Eng.). Nuovo Cimento (10), 37: 1422-45 (June 16, 1965).

A formula to express the discontinuity across a normal threshold cut in a single variable of a multiparticle amplitude is proposed, a possible derivation in S-matrix theory is discussed, and some simple properties of the formula are derived. An attempt is made to investigate how the multiparticle unitarity equations are built up as total discontinuity, normal threshold by normal threshold and to verify that the order in which different channels are included is irrelevant, and the sense in which the multiparticle unitarity equations can be said to be crossing symmetric is discussed. To simplify the discussion singularities other than normal thresholds are neglected. (auth)

31038 ON THE SPURION THEORY OF STRANGE PARTICLES. H. P. Duerr and W. Heisenberg (Max-Planck-Institut fur Physik und Astrophysik, Munich). Nuovo Cimento (10), 37: 1446-86(June 16, 1965).

In the nonlinear spinor theory which only involves spinor-isospinor field operators, strange-particle states may be constructed under the assumption of a ground state unsymmetrical with respect to isospin: spurions carrying isospin can be detached from the ground state and attached to systems constructed from local field operators to form strange particles. In addition to isospin, further properties have to be attributed to the spurions to be consistent with the requirements of Lorentz- and CPT-invariance of the vacuum. Three such possibilities present themselves: The first possibility which adds a parity property was considered earlier. Its group-theoretical implications (e.g., odd $\Lambda\Sigma$-parity) are in contradiction to present experimental evidence; therefore this possibility is ruled out. Hence the second possibility, which adds a hypercharge property, is studied. The spurion systems then transform according to representations of U_2. One finds that the combination $I(I+1) - \frac{1}{4}Y^2$, known in connection with broken SU_3, appears automatically in the factor multiplying the eigenvalue operator for the simplest bosons due to the characteristic form of the field equation and the permutation properties of the spurions. The eigenvalue operators of baryons of spin ½ are multiplied by a factor containing $aBY + b[I(I+1) - \frac{1}{4}Y^2]$ (B = baryon number) if the simplest bosons are taken into account in the self-interaction. Although the I, Y operators of the broken SU_3 appear, the group SU_3 is never assumed nor established, and hence the characteristic grouping of particles into 1, 8, 10 etc. cannot be derived group-theoretically. It is interesting, however, to observe that a grouping of 8 for the simplest bosons follows naturally from dynamical considerations. (auth)

31039 STRANGE-PARTICLE COUPLING CONSTANTS. H. P. Duerr and W. Heisenberg (Max-Planck-Institut fur Physik und Astrophysik, Munich). Nuovo Cimento (10), 37: 1487-1510(June 16, 1965).

Effective coupling constants of the spin-zero mesons η,π,K with the baryons N,Λ,Σ,Ξ are calculated within the framework of the spurion theory of strange particles of Dürr and Heisenberg using a method developed by Yamazaki, Dhar, and Katayama. The predictions based on these calculations are quite different from predictions derived from

an approximate validity of SU_3 symmetry. In particular, the η and π pseudoscalar coupling constants for all baryons should be roughly the same and approximately equal to 4π. In the calculation corrections resulting from the dressing of the baryon and the vertex are neglected, which, however, would cancel each other in case of zero boson mass due to Ward's identity. Hence it is expected that the inclusion of these effects will lead to some modification of the coupling constants calculated here which is small for the π but may be larger for η and K. The explicit isospin hypercharge branching coefficients of the various states are given. (auth)

31040 CORRECTIONS DUE TO ABSORPTION IN THE REACTION $p\bar{p} \rightarrow \Lambda\bar{\Lambda}$. G. Cohen-Tannoudji and H. Navelet (Centre d'Etudes Nucleaires, Saclay, France). Nuovo Cimento (10), 37: 1511-23(June 16, 1965). (In French)

The $p\bar{p} \rightarrow \Lambda\bar{\Lambda}$ reaction is studied under the assumption that it mainly proceeds through K^* exchange. Such a picture is however incorrect to describe production in the low partial waves, for which almost pure absorption is expected. It is then corrected, in order to take care of the competing channels. The results compare very well with present experimental data. (auth)

31041 RELATION BETWEEN THE COUPLING CONSTANT AND THE SINGULARITY IN THE SECOND SHEET. [PART] II. A. O. Barut and T. Sawada (Univ. of Colorado, Boulder). Nuovo Cimento (10), 37: 1531-52(June 16, 1965).

The universal function R(a) whose roots determine the coupling constants is studied in detail, in particular its dependence on the contour of integration and its analytic continuation. Then complete dominancy of a single crossed pole term at a particular value of s is investigated. The results are then applied to the pion-nucleon coupling constant g^2 by using helicity amplitudes of various processes in which g^2 appears, such as the π-N and N-N scatterings. The consistency of the method is checked by obtaining the same value of g^2 (within 1%) in all cases. The computed value is $g^2/4\pi = 13.96$. The method of analytic continuation in a sense implies charge independence in that it gives besides the π^0 coupling constant g, also the charged pion coupling constant $\sqrt{2}g$. (auth)

31042 INTERACTION OF FOCUSED LASER RADIATION WITH A BEAM OF CHARGED PARTICLES. G. Toraldo di Francia (Universita, Florence). Nuovo Cimento (10), 37: 1553-60(June 16, 1965).

A charged particle is assumed to be shot through the focal region of a high-intensity laser beam concentrated by a lens. It is shown that, to a first approximation, no net acceleration is experienced by the particle, no matter what amplitude distribution may be produced on the lens pupil. To the same approximation, no bunching is obtained if a beam of charged particles is shot through the focal region. (auth)

31043 K-MATRIX MODEL OF PERIPHERAL INTERACTIONS. K. Dietz and H. Pilkuhn (CERN, Geneva). Nuovo Cimento (10), 37: 1561-82(June 16, 1965).

A unitary S-matrix for peripheral interactions at a few Bev including two- and three-particle channels is constructed by means of the K-matrix. For two-quasiparticle channels its elements are approximated by Born terms while uncorrelated three-particle channels are described by a statistical K-matrix. Both assumptions are discussed and the tools for practical applications are given. (auth)

31044 ON THE CONSTRUCTION OF HIGHER SYMMETRY GROUPS. W. Ruehl (CERN, Geneva). Nuovo Cimento (10), 37: 1629-37(June 16, 1965).

The translation operators are defined as the generators of a certain invariant subgroup of a higher-symmetry group, and some necessary conditions for them are derived which concern their minimal number and possible commutation relations. (auth)

31045 ANALYSES OF MUON ELECTRODYNAMIC TESTS. J. A. McClure and S. D. Drell (Stanford Univ., Calif.). Nuovo Cimento (10), 37: 1638-46(June 16, 1965). (SLAC-PUB-67)

A simple model for a possible modification of the fermion propagator in quantum electrodynamics is presented along with the accompanying change in the vertex function directed by the Ward-Takahashi identity in order to maintain current conservation. This model is used to compute corrections to the calculations of the muon g−2 value, to the μ-pair production and to the muon-proton scattering cross sections. The purpose is to show by explicit calculation, and thereby to emphasize, that these are independent and complementary probes of the theory. Therefore, each measurement should be carried out to a maximum obtainable accuracy independent of the results found in the other two. (auth)

31046 DO THE $3/2^+$ BARYONS BELONG TO THE REPRESENTATION 10 OF SU_3? B. Diu (CERN, Geneva) and H. R. Rubinstein. Nuovo Cimento (10), 37: 1673-85(June 16, 1965).

The classification of the $3/2^+$ baryons in the representation 10 of SU_3 is re-examined in the light of recent evidence for the possible existence of a $3/2^+$ 27-plet. It is found that the mass formula (equal spacing rule) alone is not sufficient to decide whether these baryons belong to a pure unitary decuplet or result from strong 10-27 mixing. Some consequences of this latter scheme are derived, and it is shown in particular that it does not solve the problems related to the widths of the $3/2^+$ resonances. An experimental test is proposed that could confirm or infirm the 10 assignment independently from the mass formula; the experiment, though difficult, does not look impossible, and seems worth performing, due to its crucial importance for unitary symmetry. (auth)

31047 THE HIGH-ENERGY BEHAVIOUR OF THE REAL PART OF THE ELASTIC-SCATTERING AMPLITUDE. A. Bialas and E. Bialas (CERN, Geneva). Nuovo Cimento (10), 37: 1686-1701(June 16, 1965).

A relation between the high-energy behavior of the real part of the elastic scattering amplitude and the high-energy behavior of its imaginary part is discussed. Using the Phragmèn-Lindelöf theorem the formulas which express this relation are derived. Under the assumption that the elastic amplitude becomes purely imaginary in the limit of infinite energy, these formulas suggest a simple five-parameter description of the high-energy behavior of: i) the total cross sections for the collisions A + B and A + $\bar{B}$, where $\bar{B}$ is an antiparticle of B, and ii) the ratio X between the real and imaginary parts of the forward scattering amplitude for the corresponding elastic reactions. It is proved that the existing data for nucleon-nucleon scattering can, in fact, be described in this way. The results are consistent with the calculation based on the dispersion relations. The asymptotic formulas also show that: a) from the fact that the total cross sections are going down with energy, it follows that the real part of the forward-scattering amplitude should be negative at high energies, and b) from the fact that the total $p\bar{p}$ cross-section changes with energy much more than the total pp cross section, it follows that the absolute value of the ratio X should be smaller for $p\bar{p}$ scattering than for the pp scattering. The more general case when the ratio between the real and imaginary parts of the forward elastic amplitude tends to a nonvanishing limit at high energy was also considered. For nucleon-nucleon scattering the present day data suggest that the absolute value of the ratio X at infinite energy is smaller than 0.2. (auth)

31048 REMARKS ON AN ENLARGED POINCARE GROUP; INHOMOGENEOUS SL(6,C) GROUP. H. Bacry and J. Nuyts (CERN, GENEVA). Nuovo Cimento (10), 37: 1702-11(June 16, 1965).

The inhomogeneous SL(6,C) group, as generalizing relativistically SU6, did not seem very attractive to physicists, due to the fact it possesses 36 translation operators. A physical interpretation of this group is given in which many of the 36 momenta are physically meaningless. Moreover, this interpretation leads in a natural way to mass relations without any breaking of the group. Some proper-

ties of SL(6,C) and its inhomogenized groups are given such as commutation rules, irreducible representations, etc. (auth)

31049 A RELATIVISTIC STRONGLY SINGULAR POTENTIAL. A. P. Contogouris (CERN, Geneva). Nuovo Cimento (10), 37: 1712-23(June 16, 1965).

As a relativistic model of a potential, which at the origin is more singular than $1/r^2$, the Bethe-Salpeter equation for the scattering of two spinless bosons via exchange of zero-mass spin-2 particles is considered. It is shown that certain properties characteristic of nonrelativistic strongly singular potentials, namely, nonanalyticity of the wave function in the coupling constant g at g = 0, meromorphy of the partial waves in the complex angular momentum l and the existence of a reflection property in l (for g < 0), do characterize the present model as well. In an approximation which retains the basic features of the problem an explicit solution is given. (auth)

31050 MASS SPLITTING OF PARTICLES AND COMPOSITE MODEL. S. Ishida (Nihon Univ., Tokyo). Nuovo Cimento (10), 37: 1724-7(June 16, 1965).

The mass splitting (including the electromagnetic one) of SU_3 multiplets is discussed from the viewpoint that the origin of the symmetry breakdown is merely due to the existence of mass difference among the fundamental particles of which all particles are composed. A fundamental triplet ur-baryon $t(p_0, n_0, \Lambda_0)$ is assumed. (C.E.S.)

31051 SU_6 AND NONLEPTONIC WEAK INTERACTIONS. C. Iso and M. Kato (Tokyo Inst. of Tech.). Nuovo Cimento (10), 37: 1734-8(June 16, 1965).

Consequences of the extended Wigner's supermultiplet theory, SU_6 model, in the nonleptonic weak interactions are discussed. It is assumed that the baryons belong to the 56-dimensional representation. The s- and p-wave amplitudes for the nonleptonic hyperon decays are considered, and sum rules are obtained. (C.E.S.)

31052 OPTICAL POTENTIAL APPROACH TO p-p LARGE-ANGLE SCATTERING. G. A. Armoudian, D. Ito, and K. Mori (Louisiana State Univ., Baton Rouge). Nuovo Cimento (10), 37: 1739-42(June 16, 1965).

An attempt is made to describe large angle p-p scattering by an optical potential. It is assumed that the region of interaction leading to large-angle scattering is highly Lorentz contracted, and interaction in the region is described by a contracted optical potential. Fourier transforms of large-angle scattering amplitudes are used to obtain information on the explicit form of the phenomenological potentials. (C.E.S.)

31053 ON THE BOOTSTRAP SOLUTION OF A SOLUBLE MODEL. E. J. Squires (Univ. of Durham, Eng.). Nuovo Cimento (10), 37: 1749-51(June 16, 1965).

The relation between an exact and a one-pole approximation treatment of a soluble one-dimensional model with a simple crossing relation for the amplitude discussed previously by Diu and Rubinstein (Phys. Lett., 8: 203(1964)) is considered. They showed that whereas the exact treatment permitted solutions with arbitrary values of the coupling constant and mass, the approximate method yielded self-consistency conditions on these quantities. It is shown that the essential difference between these two results lies not in the use of an approximation but in the fact that CDD poles were permitted in the first treatment and not in the second. It is also shown that there is no solution of this problem containing a bound state which is not a CDD pole. (C.E.S.)

31054 RESONANCES AND THE BEHAVIOR OF THE PHASE OF THE ANALYTIC TWO-CHANNEL S-MATRIX. T. Kanki (Purdue Univ., Lafayette, Ind.). Nuovo Cimento (10), 37: 1769-73(June 16, 1965).

The behavior of the phase of the analytic two-channel S-matrix is discussed, and it is shown that some resonances cause discontinuities of this phase, equal to 2π in magnitude, in the physical region. The validity of the one-channel N/D method is discussed in terms of this phase behavior. (C.E.S.)

31055 SOME NON-BORN PHASE SHIFTS. T. Tietz (Univ. of Lodz, Poland). Nuovo Cimento (10), 37: 1774-6 (June 16, 1965).

A formula for the non-Born phase shifts is derived, which is a generalization of the Swan and Brysk formulas. A formula for the phase shifts for long and short range potentials is also given. These formulas give some clarification to the procedure for obtaining non-Born phase shifts. (C.E.S.)

31056 X^0-η MIXING AND SOME RADIATIVE MESON DECAY PROCESSES. R. H. Dalitz and D. G. Sutherland (Oxford Univ.). Nuovo Cimento (10), 37: 1777-84(June 16, 1965).

Mixing between the meson (X^0) (959 Mev) and the meson (η) (548.7 Mev) is investigated by examining the matrix element of the mass operator between these states. The Gell-Mann-Okubo mass formula and the quark model are used. The $X^0 \to \omega + \gamma$ and $X^0 \to \rho^0 + \gamma$ decay processes are discussed. The effects of X^0-η mixing on the 28 decay models for X^0, η, and π^0 and the $\varphi \to \eta + \gamma$ are considered. (C.E.S.)

31057 PSEUDOSCALAR MESON-BARYON INTERACTION AND η MESON PRODUCTION IN K^--p COLLISION. S. Minami (Osaka City Univ.). Nuovo Cimento (10), 37: 1785-8(June 16, 1965).

A $K^- + p \to \Lambda + \eta$ reaction is studied with the assumption that the η-Λ interaction has properties similar to those of η-N interaction. The existence of a resonant state Y_0^* (1662) with isotopic spin I = 0 corresponding to the $N_{\frac{1}{2}}^*$ (1485) is predicted, and the question of whether or not the Y_0^* (1662) should be regarded as a resonance in the $\overline{K}$-N system is discussed. The possibility is pointed out that events of the Y_0^*(1662) are misinterpreted and are contained in events of the Y_1^* (1660). (C.E.S.)

31058 Σ^0-Λ^0 ISOSPIN MIXING. Ramesh Chand (Wayne State Univ., Detroit). Nuovo Cimento (10), 37: 1789-91 (June 16, 1965).

A means of testing the isospin purity of hyperons (Σ^0) and (Λ^0) based on meson (K^-)-deuterium absorption reactions is proposed. (C.E.S.)

31059 SEARCH FOR THE DECAY MODE $K^+ \to \pi^+ + \mu^+ + \mu^-$. U. Camerini (Univ. of Wisconsin, Madison), D. Cline, G. Gidal, G. Kalmus, and A. Kernan. Nuovo Cimento (10), 37: 1795-6(June 16, 1965). (COO-881-48)

A search was made for the decay mode $K^+ \to \pi^+ + \mu^+ + \mu^-$ in film from a stopping K^+ run in the heavy liquid bubble chamber filled with C_3F_8. A total of 461 decays were selected which satisfied the following criteria: the K^+ decays at rest to three charged particles. All three secondaries terminate in $\mu^+ \to e^+ \nu \bar{\nu}$ decay. All events were consistent with the decay sequence $K^+ \to \pi^+ + \pi^+ + \pi^-$ followed by $\pi^- \to \mu^- + \bar{\nu}$. The absence of any examples of $K^+ \to \pi^+ + \mu^+ + \mu^-$ leads to an upper limit $B \leq 3.0 \times 10^{-8}$ at the 10% significance level, where B is the branching ratio. (C.E.S.)

31060 A SIMPLE TEST FOR ANGULAR MOMENTUM OF RESONANCES. S. H. Patil (Inst. for Advanced Study, Princeton, N. J.). Nuovo Cimento (10), 37: 1797-8(June 16, 1965).

The production of multiparticle resonances is considered. A test for the angular momentum of resonances that is independent of the final decay products as well as the mechanism of production is proposed. (C.E.S.)

31061 CONSTRUCTIVE APPROACH IN THE METHOD OF EXTENSION. G. Sandri and R. Sullivan (Aeronautical Research Associates of Princeton, N. J.). Nuovo Cimento (10), 37: 1799-1800(June 16, 1965).

A procedure for determining the fundamental variables required by the method of extension is given. The construction allows for the introduction of arbitrary scaling functions which are determined by the requirement that the expansion of the unknown function be uniformly valid. (C.E.S.)

31062 NON-LEPTONIC HYPERON DECAYS AND THE 27-PLET WEAK HAMILTONIAN. K. C. Gupta

(Univ. of Delhi) and Rabi Majumdar. Nuovo Cimento (10), 37: 1801-4(June 16, 1965).

When the current-current picture for weak interactions is considered and CP invariance is assumed, it follows that the weak hamiltonian H_w must transform either like a singlet or like an octet or like a 27-plet. The possibility that H_w transforms purely like a 27-plet is considered, and the consequences for the nonleptonic decays of hyperons are investigated. (C.E.S.)

31063 ON SU_n SYMMETRIES IN UNITARY SPACE AND THEIR SU_{2n} EXTENSIONS TO SPIN-UNITARY SPIN SPACE. B. Gruber (Istituto Nazionale di Fisica Nucleare, Naples) and B. Vitale. Nuovo Cimento (10), 37: 1805-9(June 16, 1965).

It is shown that once an SU_n symmetry is assumed in unitary spin space and the physical fermions (bosons) are built up from a threefold direct product of self-representations of SU_n (from the direct product of the self-representation of SU_n and its conjugate, respectively), an SU_{2n} spin-unitary spin extension is always possible and the spin structure of the SU_n multiplets is defined by the extension, independently of n. (C.E.S.)

31064 A NEW APPROACH TO SCATTERING BY SINGULAR POTENTIALS. S. Fubini (Universita, Turin and CERN, Geneva) and R. Stroffolini. Nuovo Cimento (10), 37: 1812-16(June 16, 1965).

A new point of view in the study of singular potentials, which allows a systematic treatment of a large class of potentials, is discussed. The approach proposed is essentially based on the study of the polydromy of the wave function $\psi(r)$ in the r variable. The important point is that both singular and regular potentials exhibit very simple and general features in this framework. (C.E.S.)

31065 U_{12} PREDICTIONS FOR A^* PRODUCTION BY NEUTRINOS. G. Altarelli (Universita, Florence), G. Preparata, and R. Gatto. Nuovo Cimento (10), 37: 1817-19 (June 16, 1965).

CERN data on N* production by high-energy neutrinos is compared with the predictions of the broken U_{12} symmetry. In contrast to phenomenological treatments, U_{12} predicts unique expressions for the weak N^*-N vector and axial currents. The vector N^*-N current is given directly in terms of the known nucleon electromagnetic form factors. The axial N^*-N current is similarly given in a definite form in terms of the axial nucleon form factor. The N* production cross section is calculated in U_{12} and compared with the CERN data. (C.E.S.)

31066 RADIATIVE CORRECTIONS TO MUON DECAY WITH FINITE NEUTRINO MASS. G. R. Allcock (Univ. of Liverpool). Proc. Phys. Soc. (London), 85: 875-96(May 1965).

Formulas are obtained for the dependence of the muon decay electron spectrum on the mass of the muon's neutrino, with both radiative and intermediate boson corrections included by convenient and accurate approximation methods. The restrictions which the usual V−A prescription places on the form of the decay interaction are relaxed in the calculations to the extent that either the electron or the muon is assumed to be coupled by an arbitrary mixture of vector and axial vector terms. The range of neutrino mass values consistent with available measurements of the electron end-point energy is reassessed, the shape of the spectrum near the end-point being taken into consideration. (auth)

31067 NUCLEON-NUCLEON SCATTERING AND f^0-MESON. Ino, Taketoshi; Matsuda, Masanori; Sawada, Shoji (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 33: 489-99(Mar. 1965).

On the basis of the one-boson-exchange-contribution model, the effects of the newly observed bosons (meson (f^0), meson (φ), and meson (B)) on N-N scattering are investigated. The meson (f^0), if it is I = 0 (2^+) tensor boson, can improve the agreement of the model with experiments. The contributions of the heavy vector bosons (meson (φ) and meson (B)) are not necessarily required for nuclear force as far as the energies below 300 Mev are concerned. (auth)

31068 COMPLEX SINGULARITY AND UNITARITY. Mishima, Nobuhiko; Yamazaki, Miwae (Tokyo Metropolitan Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 33: 500-9(Mar. 1965).

The partial-wave amplitudes of a particular five-point scattering are investigated as an extension of four-point amplitudes due to analytic continuation in squared mass of one of their four lines. From this point of view, the appearance of an anomalous complex singularity in this continuation is due to the circumstance that a new channel is opened as the particle becomes unstable. Thus, the generated complex anomalous cut corresponds to the unitarity cut of the new open channel. In this way, the imaginary part of the contribution from the complex anomalous cut can be found and its real part can be written by an integral along the real axis. This procedure is very useful for practical calculations of scattering problems including unstable particles. (auth)

31069 CHARGE EXCHANGE CURRENT-CURRENT WEAK INTERACTION ACTING UNIVERSALLY AMONG LEPTONS AND B-MATTERS. Matumoto, Ken-iti (Kanazawa Univ., Japan). Progr. Theoret. Phys. (Kyoto), 33: 539-41(Mar. 1965).

A weak interaction caused by the charge-exchange, current-current interaction acting universally among leptons and B-matters is proposed. A $|\Delta I| = \frac{1}{2}$ strangeness-changing nonleptonic weak interaction is obtained, together with a $\Delta I = 0$ strangeness-conserving nonleptonic weak interaction. (D.C.W.)

31070 INTERNAL STRUCTURE AND SYMMETRY OF ELEMENTARY PARTICLES. [PART] III. Katayama, Yasuhisa; Yamada, Eiji; Yukawa, Hideki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 33: 541-3(Mar. 1965).

A model of elementary particles with internal structure is proposed in which a quadrilocal field is included. (D.C.W.)

31071 THE GROUP SL(2,R) AND INTERNAL STRUCTURE OF ELEMENTARY PARTICLES. Hillion, Pierre (Universite, Paris). Progr. Theoret. Phys. (Kyoto), 33: 543-5(Mar. 1965).

It was recently shown that in the Yukawa theory of nonlocal fields, the infinitesimal operators of the Lorentz group L(2 + 1) in three-dimensional Minkowski space provide a new internal symmetry. The importance of these operators in the relativistic rotator theory is proved. It is shown that SL(2,R), the little group of the proper inhomogeneous Lorentz corresponding to space-like quadrivectors, is preferable to SU_2 as the little group in the theory of the internal structure of elementary particles. (D.C.W.)

31072 MASS LEVELS OF SPIN $\frac{3}{2}$ RESONANT STATES AND Ω^- BARYON. Hiraki, Hiromichi; Katsumori, Hiroshi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 33: 546-8 (Mar. 1965).

It is shown that by introducing three gauge fields associated with the conservation of baryon number, strangeness, and isospin, the masses of the $J = \frac{3}{2}$ resonant states can be obtained by careful selection of coupling constants and cutoff momenta. The mass of the hyperon (Ω^-) is also considered; the results indicate that it is a $J = \frac{1}{2}$ particle. (D.C.W.)

31073 ON THE SOFT-PHOTON RADIATIVE CORRECTIONS TO HIGH-ENERGY ELECTRON-ELECTRON SCATTERING. Baba, Kazuo (Nara Women's Univ., Pakistan). Progr. Theoret. Phys. (Kyoto), 33: 548-50(Mar. 1965).

The contribution to the cross section for high-energy electron-electron scattering from soft-photon emission is studied with emphasis on some terms in the radiative corrections that depend only on the scattering angle. (D.C.W.)

31074 THE BOOTSTRAP CONDITIONS AND THE VANISHING Z_3-FACTOR FOR UNSTABLE PARTICLES. Saito,

Satoru (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 33: 550-2(Mar. 1965).

It is shown that the equivalence between the bootstrap conditions and the condition for the wave-function renormalization constant Z_3 to vanish holds for unstable particles in a model analogous to that considered previously (Progr. Theoret. Phys. (Kyoto), 33: 307(1965)) for the case of stable particles. (D.C.W.)

31075 TRANSVERSE NUCLEON POLARIZATION IN ELASTIC LEPTON PRODUCTION BY HIGH ENERGY NEUTRINO. Fujii, Akihiko; Yamaguchi, Yoshio (Sophia Univ., Tokyo and Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 33: 552-4(Mar. 1965).

It is shown that the transverse polarization of the proton in the interaction $\nu + n \rightarrow p +$ lepton is appreciable in Cabibbo's model with certain parameters, provided that the initial nucleon is unpolarized and that the spin of the final lepton is not observed. (D.C.W.)

31076 NEW METHOD FOR SEMICLASSICAL ESTIMATION OF SCATTERING PHASES. N. J. Ionescu-Pallas (Inst. of Atomic Physics, Bucharest). Rev. Roumaine Phys., 9: 837-44(1964). (In French)

The phase, η_l, is no longer determined by the usual WKBJ method but by a different method. A function change was introduced which transforms the Schroedinger equation into a second-degree equation in $d\eta_l/d\,r$. It is also shown that the justification indicated by Langer for the approximation of the quantity $l(l+1)$ which appears in the expression of the phase by $(l+\frac{1}{2})^2$ and which is usually found in the phase formula is not justified. The cross section for elastic scattering concerning a potential of the Yukawa type and another potential of the form k/r^2 was calculated. (tr-auth)

31077 A REPRESENTATION OF THE S-MATRIX ELEMENT FOR A HIGHLY SINGULAR POTENTIAL. Yuan-ben Dai (Academia Sinica, Peking). Sci. Sinica (Peking), 14: 689-94(May 1965).

For the highly singular potential a representation for the S-matrix element $S(\lambda,k)$ is proved, based on symmetric properties of $S(\lambda,k)$ and previous results. It is shown that the Watson-Sommerfeld transformation can not be performed for some special cases. (L.B.S.)

31078 THE ASYMPTOTIC REGGE BEHAVIOUR FOR THE NONLOCAL POTENTIALS $(e^{-\mu r}/r)\cdot(e^{-\mu r'}/r')\cdot(e^{-\alpha R}/R)$ AND $(e^{-\mu r}/r)\cdot(e^{-\mu r'}/r')\cdot(e^{-\sqrt{\alpha(r+r')}R}/R)$. Lon-shiang Chou and Yuan-ben Dai (Academia Sinica, Peking). Sci. Sinica (Peking), 14: 695-704(May 1965).

For the nonlocal potentials $U(r, r', R) = (e^{-\mu r}/r)\cdot(e^{-\mu r'}/r')\cdot(e^{-\alpha R}/R)$ and $U(r, r', R) = (e^{-\mu r}/r)\cdot(e^{-\mu r'}/r')\cdot(e^{-\sqrt{\alpha(r+r')}R}/R)$ it is proved that the S-matrix element $S(\lambda, k)$ is meromorphic in the topological product of the half λ-plane $\mathrm{Re}\lambda > -\frac{1}{2}$ and the whole k-plane cut along $(-i\infty, 0)$ and $(i\mu, +i\infty)$ and that for large $|\lambda|$, $S(\lambda, k) - 1 = 0\{(1/\lambda^{\lambda})\exp - \lambda\ \mathrm{ch}^{-1}[1 + (\mu^2/2k^2)]\}$ for $k > 0$ and $|\arg\lambda| \leq (\pi/2)$. (auth)

31079 DIAGRAM TECHNIQUES FOR SOLUTION OF NONRELATIVISTIC THREE-BODY PROBLEM. V. V. Komarov and A. M. Popova. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 48-61(Nov.-Dec. 1964). (In Russian)

By means of the method of summation of nonrelativistic diagrams of the perturbation theory, integral equations for the amplitude of the interaction of three nucleons were obtained under the hypothesis that new intensities essentially appeared. For simplicity the calculations were developed for spinless particles. The equations obtained contain half as many variables as the corresponding Schroedinger equations. The fundamental properties of the nonrelativistic diagrams of the perturbation theory were considered. It was shown that the method of summation of diagrams can be extended to the solutions of problems of the interaction of a large number of nucleons. (tr-auth)

31080 THE USE OF KOTEL'NIKOV'S THEOREM IN THE SPECTROMETRY OF CONTINUOUS ENERGY SPECTRA OF RADIATION. V. A. Fedorov and G. G. Doroshenko. Vopr. Dozimetr. i Zashchity of Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 65-71(1964). (In Russian)

During the study of continuous radiation spectra, the Fredholm first order integral equation, $F(E') = \int_0^\infty f(E)K(E, E')dE$, connecting the differential distribution of pulse amplitudes $F(E')$ with the differential energy spectrum $f(E)$ is frequently encountered. The feasibility of an analytic representation of $f(E)$ free from the usual shortcomings of the polynomial representation is discussed. It is based on the theorem due to V. A. Kotel'nikov, which states that an arbitrary function can be represented exactly using frequencies between 0 and ω_{max} if the function is sampled at intervals π/ω_{max} seconds apart. The results showed that by the use of this the accuracy of quadratures of approximate solutions of problems of spectrometry can be augmented and well-defined systems of linear equations can be obtained. (CFSTI)

31081 FUNCTIONAL SOLUTION SCHEME FOR RELATIVISTIC STRONG-COUPLING THEORY. [PART] III. Gerhard Heber (Universitat, Leipzig), Adolf Kuehnel, and H. J. Kaiser. Z. Naturforsch., 20a: 498-503(Apr. 1965).

The graph scheme previously developed was further investigated. The structure of the coefficients α_k was determined in terms of α_0 and the projections of the splitting graphs. This allows a formal summation of the k-series. The first few terms of the strong coupling series for the lowest mass eigenvalue were computed for the $\lambda\varphi^4$ theory. The leading term for large λ is complex. This restricts physically acceptable solutions to λ below some critical value. By including a bare mass m in the Lagrangian, the α_k become dependent on it. Consideration of one α_k e.g. $\alpha_0(m,\lambda)$ should then be sufficient for the determination of physical mass eigenvalues. (auth)

31082 TEST OF CABIBBO'S THEORY OF CP-VIOLATION IN NEUTRINO REACTIONS. R. R. Silbar (Johns Hopkins Univ., Baltimore) and H. Ueberall. Z. Naturforsch., 20a: 638-40(Apr. 1965).

Cabibbo (N. Cabibbo, Phys. Letters 13, 562 (1964)) assumes that the strongly interacting weak current $J\lambda$ transforms as a member of an SU_3 octet. Then, if the non-leptonic weak Lagrangian violates CP, $J\lambda$ must contain both regular and irregular parts with respect to behavior under CP. The latter give rise to second class currents of a special kind, viz., being 90° out of phase with the first class currents deriving from the regular parts, thus leading to a maximal violation of CP and, through the CPT theorem, of T. It is the interference between the two types of currents that gives T- and CP-violating effects. Since these contributions are of a forbidden type, they should be most easily observed in high-momentum-transfer reactions and would have escaped detection in β decay. Tests were made of this theory. (P.C.H.)

31083 POLARIZATION EFFECTS IN ELASTIC ELECTRON-DEUTERON SCATTERING. Dieter Schildknecht (Universitat, Munich). Z. Physik, 185: 382-99(1965).

The vector and tensor polarization of the deuteron after scattering and the dependence of the cross section on the polarization before scattering are given for elastic electron-deuteron scattering treating the deuteron as a spin 1 elementary particle characterized by three electromagnetic form factors and describing the interaction by the first Born approximation. By using polarization measurements a separation of the charge and quadrupole form factors may be accomplished, and thus the assumptions may be tested, which are necessary for the extraction of the isoscalar nucleon form factors from the deuteron form factors. (auth)

31084 COMPOSITE ELEMENTARY PARTICLES AND SELF-DAMPING OF FERMI INTERACTIONS. W. Guettinger (Universitat, Munich). Z. Physik, 185: 407-20(1965).

It is shown that the bootstrap and $Z = 0$ mechanisms of composite elementary particle theories emerge from a Fermi theory. The self-damping of Fermi interactions is demonstrated: Such theories are finite at the outset and need no indefinite metric for their definition. A mathe-

matically rigorous peratization scheme is set up rendering unrenormalizable theories finite in terms of perturbation theory. (auth)

31085 ON THE DISTURBANCE OF CP-INVARIANCE AND NEUTRAL LEPTON CURRENT IN WEAK INTERACTIONS. E. M. Lipmanov (Volgograd Pedagogical Inst., USSR). Zh. Eksperim. i Teor. Fiz., 48: 750-2(Feb. 1965). (In Russian)

In view of the localized character of CP-invariance in weak interactions, it might be possible to encounter neutral leptons in DP-noninvariant processes with a change in strangeness such as $K^+ \to \pi^+ + e^+ + e^-$, $K^+ \to \pi^+ + \mu^+ + \mu^-$, and $K^+ \to \pi^+ + \nu + \bar{\nu}$. The relative probability of this type of decay involving an intermediate boson is $\sim 1 \times 10^{-7}$. Polarization of the particles would be further confirmation of the mechanism of decay. If the mass of the intermediate boson is not large compared to the nucleon mass, there is a unique possibility of observing the resonance production of separate strange particles (K^- + π^+ and others) in future experiments with colliding electron-positron beams. (TTT)

31086 ANNIHILATION OF ANTIBARYONS AND UNITARY SYMMETRY. M. P. Rekalo (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 48: 756-8(Feb. 1965). (In Russian)

The relations between the amplitudes of formation of a baryon-antibaryon pair are investigated during the annihilation of $\bar{p}$ and $\bar{\Sigma}^+$ particles on protons. The following processes are considered: $f_1)\ \bar{p} + p \to \bar{\Omega}^- + \Omega^-$, $f_2)\ \bar{p} + p \to \bar{\Xi}^{*+} + \Xi^{*-}$, $f_3)\ \bar{p} + p \to \bar{Y}_1^{*-} + Y_1^{*-}$, $f_4)\ \bar{p} + p \to \bar{N}^{*-} + N^{*-}$, $f_5)\ \bar{\Sigma}^+ + p \to \bar{\Omega}^- + \Xi^{*-}$, $f_6)\ \bar{\Sigma}^+ + p \to \Xi^{*-} + Y_1^{*-}$, and $f_7)\ \bar{\Sigma}^+ + p \to \bar{Y}_1^{*-} + N^{*-}$. The relations between the amplitudes of these processes at a level of unitary symmetry are discussed. The strong interaction which violates unitary symmetry but conserves isotopic spin and the charge (a moderately strong interaction) is taken into account. The relations between the f_i amplitudes for a peripheral mechanism depends on the value of the U-spin of the intermediate meson state: if U = 1, $f_1 = 0$, $f_2 = -f_3/2 = f_4/3 = f_5/\sqrt{3} = -f_6/2 = f_7/\sqrt{3}$, and if U = 2, $-f_1/4 = f_2/3 = -f_3/2 = f_4 = -f_5/\sqrt{3} = f_6/2$. The moderately strong interaction is included. (TTT)

31087 INVESTIGATIONS OF ELASTIC p-p SCATTERING AT HIGH ENERGIES BY MEANS OF TRANSISTOR COUNTERS. Yu. K. Akimov, A. I. Kalinin, V. A. Nikitin, V. S. Pantuev, V. A. Sviridov, A. I. Sidorov, and M. N. Khachaturyan. Zh. Eksperim. i Teor. Fiz., 48: 767-9 (Feb. 1965). (In Russian)

Solid-state counters were placed in vacuum at an angle of 87.7° to a proton beam at a distance of 3 meters from a target which was struck by 10-Bev protons. The target was an organic polymeric film 0.7 μ thick. The dimensions of the surface-barrier counter were $3 \times 4 \times 0.09$ mm^3. The counting time was 10 minutes. The amplitude analyzer clearly showed a peak due to 2.2-Mev recoil protons. The peak width at half the height was 330 kev (15%). The half width $\Delta E/E$ was ~18% in a nuclear emulsion, that is, somewhat broader than the distribution obtained with the solid-state counter. Protons whose range is included in a silicon layer 0.7 mm thick can be identified by the solid-state counter. (TTT)

31088 LIE GROUPS FOR PEDESTRIANS. Lipkin, Harry J. Amsterdam, North-Holland Publishing Co. and New York, John Wiley and Sons, Inc., 1965. 167p. $6.00.

An attempt is made to show how the techniques of angular momentum algebra can be extended to treat other Lie groups and to give several examples illustrating the application of the method. The essential features of the method are presented by analogy with angular momentum, and it is pointed out that bilinear products of creation and annihilation operators lead to Lie algebras. Isospin is presented as an example of the method. The group SU_2 and its application to elementary particles are considered. The three-dimensional harmonic oscillator is treated using SU_3, and its applications to nuclear structure are discussed. The classification of Lie algebras of bilinear products of creation and annihilation operators, symplectic groups, and the applications to pairing correlations and seniority in many-particle systems are considered. Permutation symmetry is discussed, and a simplified version of Young diagrams is given as a guide to its use. A detailed study of the application of SU_3 algebra to unitary symmetry of elementary particles is included. (C.E.S.)

31089 UEBER DIE BESTIMMUNG DER STREUAMPLITUDE FUER ELASTISCHE PROTON-PROTON-STREUUNG BEI HOHEN ENERGIEN UND KLEINEN WINKELN. (On the Determination of the Scattering Amplitude for Elastic Proton-Proton Scattering at High Energies and Small Angles). Juergen Pahl. Summary of Thesis. 8p. Full Thesis available from Bern Universitat in Microfilm Copy.

Research installations that would make it possible to determine the proton-proton scattering amplitude for energies to 24 Bev with an accuracy of several percent were investigated. Installations using nuclear emulsions and spark chambers as detectors were evaluated. The results showed significantly better results could be obtained with spark chambers. The evaluation time for spark chamber data is much less than that for emulsions. (J.S.R.)

Field Theory and Quantum Mechanics

Refer also to abstract 31020.

31090 THE ANALYTICAL PROPERTIES OF THE MONOFERMIONIC GREEN FUNCTION IN THE QUANTUM THEORY OF MULTIBODY SYSTEMS. Ioan Brandus and Liliana Moisescu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 15: 563-88(1964). (In Rumanian)

In a system of interacting particles subjected to Fermi statistics, elementary excitations or quasi-particles may occur as a result of the collective interaction. The methods of the quantum field theory, as expressed in the form of a Green function, are very useful in the investigation of multibody systems; therefore, the monofermionic Green function for multibody systems was examined as a function of complex variable. Studying the analytical properties, an attempt was made to uncover the physical meaning of the singularities. Many previous attempts have been made to calculate the Green function in the general case and in the case of concrete physical systems, making use of the perturbation theory and of Feynman diagrams. Landau used the quantum field theory to develop the general microscopic theory of a Fermi liquid at absolute zero. The work was extended more recently to 2-component Fermi liquids, distinguishing the components of the liquid on the basis of the isotopic spin. (TTT)

31091 THE "VECTORIAL" OPTICS OF FIELDS WITH ARBITRARY SPIN, REST-MASS ZERO. Jerzy Plebanski (Warsaw Univ.). Acta Physiol. Polon., 27: 361-93(Mar. 1965).

The equations of fields with spin s, rest-mass zero, corresponding to the irreducible representation of the Lorentz group D(o, s) are studied in the high frequency limit. A formula for the rotation of the planes of polarization—due to curvature—is given. The optical development, i.e., the development of the field with extracted phase factor into inverse powers of frequency, exhibits in its algebraic structure a characteristic peeling off effect. (auth)

31092 VARIATIONAL SOLUTIONS OF PERTURBATION THEORY EQUATIONS. Jeremy I. Musher (Rockefeller Inst., New York). Ann. Phys. (N. Y.), 32: 416-23 (May 1965).

A procedure is demonstrated to obtain the solution of the partial differential equations of perturbation theory by choosing the functionals to be made stationary directly from

the equations themselves. This procedure is shown to be simpler in many-particle problems than the usual Ritz-Schrödinger or Hylleraas-Bethe Salpeter procedures which choose the functionals so that their extremum values are identically equal to certain energy eigenvalues. As examples, variational principles for the second-order Hartree-Fock energy and the second-order energy of an uncorrelated system in an electric field are derived. (auth)

31093 CONSERVED VECTOR CURRENTS AND INVARIANCE PROPERTIES IN LAGRANGIAN FIELD THEORY. D. Horn (Tel-Aviv Univ., Israel). Ann. Phys. (N. Y.), 32: 444-51(May 1965).

It is shown that conserved vector currents in a local Lagrangian theory must stem from the invariance of the Lagrangian under general gauge transformations. Thus, there exists a unique way of obtaining conserved vector currents by using the generalized Noether theorem. (auth)

31094 INTENSIFIED TUNNEL EFFECT FOR COMPLEX PARTICLES. B. N. Zakhariev and S. N. Sokolov (Joint Inst. for Nuclear Research, Dubna, USSR). Ann. Physik, 14: 229-32(Nov. 1964).

A quantum-mechanical problem concerning the penetration through the potential barrier of two particles in mutually bound state (complex particle) is considered. The two interacting particles move in an external field; and the potential characterizing the interaction is an infinite square potential well and the potential acting on the first particle is in the form of a rectangular barrier. The internal structure of the complex particle leads to the spreading of the potential barrier which facilitates the penetration through this barrier. (auth)

31095 MACHIAN AND ANTI-MACHIAN SOLUTIONS OF THE FIELD EQUATIONS IN GRAVITATION. PART 2. H. Hoenl and H. Dehnen (Universitat, Freiburg i.B.). Ann. Physik, 14: 271-95(Nov. 1964). (In German)

A general, covariant formulation of the Machian principle was proposed in which the energy-impulse density of the gravitational field exerts the same influence on the conduction field as does matter. If the solution is spatially enclosed, i.e., finite, the solution conforms to the Machian principle and is also a derivation of the Einsteinian field equations. If the solution is non-finite, there are two ways for characterizing the field equations, viz., Machian and anti-Machian. The correlations between the Einsteinian field equations and the Machian solutions were discussed. (auth)

31096 SOME THOUGHTS ON THE PROBLEMS CONCERNING ENERGY AND IMPULSE IN THE GENERAL THEORY OF RELATIVITY. E. Schmutzer (Universitat, Jena, Ger.). Ann. Physik, 14: 319-21(Nov. 1964). (In German)

It is shown that the reasons which prompted Moller (Ann. Physics, 12: 118 (1961)) and others to investigate the energy-impulse on the basis of tetrade calculations rather than on the basis of the general theory of relativity are invalid and by introducing another value it is possible to obtain valid conclusions on the basis of the gravitation-field equations. (auth)

31097 ON THE THEORY OF LONGITUDINAL FOCUSING OF RADIATION ACCELERATION CLUSTERS OF CHARGED PARTICLES. V. V. Yankov. At. Energ. (USSR), 18: 402-3(Apr. 1965). (In Russian)

The specific peculiarities of spatial distribution, in particular, the radiation pressure wave on a continuous limited medium was studied in contrast to the previously discussed quasistatical effects in which the wave length in a vacuum was assumed to be larger than the size of the medium. The problem was studied as one-dimensional concept by approximating the plasma cluster as an infinite plane-parallel layer in a homogeneous medium with a dielectric constant as a function of the field frequency while the radiation acceleration field was approximated by a plane wave with the incident normal to its plane. (R.V.J.)

31098 GRAVITATIONAL RADIATION. RIEMANNIAN TENSOR IN GENERAL RELATIVITY. Robert Debever (Universite Libre, Brussels). Cahiers Phys., 18: 303-50 (Aug.-Sept. 1964). (In French)

The basic concepts, definitions, and properties of the Riemannian tensor are reviewed. A new technique for the calculation of the Riemannian connection and of the magnitudes deriving it is given. The bivector space, the Riemannian tensor, problems connected to the Bianchi equations and their propagation, and the spinor representations are derived. (J.S.R.)

31099 CONTRIBUTION TO THE QUANTIFICATION OF RELATIVISTIC THEORIES OF ELECTROMAGNETISM AND OF GRAVITATION. Philippe Droz-Vincent. Cahiers Phys., 18: 369-404(Oct. 1964). (In French)

The unitary linear problem is considered first by a review of the linear approximation of the unitary theory of Thiry. A sketch is given of the quantization of the affine and quadridimensional theory of Einstein and Schroedinger. A Riemann framework is used from which the field will be susceptible of effecting asymmetric linear fluctuations. An attempt is made in principle to quantize the rigorous equations of the unitary theory of Einstein. By making independent variables of the metrics and the connection, a linear lagrangian with respect to the velocity is desposed of. This introduces the need of an analytical mechanics adapted to the case of the linear lagrangian. The possibilities of canonical formalism with linear lagrangian are studied systemically. The bonds (constraints) that are encountered are always equations and not identities. With respect to the Einstein theory, Poisson brackets are obtained. (tr-auth)

31100 A NOTE ON THE EQUIVALENCE OF CERTAIN REALIZATIONS OF BOSON ANNIHILATION AND CREATION OPERATORS DUE TO K. O. FRIEDRICHS. H. E. Moses (Massachusetts Inst. of Tech., Cambridge). Commun. Pure Appl. Math., 17: 355-6(Aug. 1964).

The conditions for the unitary equivalence of two sets of annihilation and creation operators of the Friedrichs class are established. (D.C.W.)

31101 PARAMETRIC CONCEPT OF THE PRODUCT OF GREEN'S CAUSALITY FUNCTIONS. A. A. Asadullin and L. Sh. Khodzhaev (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 5, 63-7(1964). (In Russian)

Green's causality function plays an important role in quantum theory. In the case of nuclear reactions, it enters the expression for reaction amplitude. These amplitudes can be represented graphically, in the form of a Feynman diagram, making use of the correspondence principle. Conversely, if the flow character of the reaction is known, i.e., its flow diagram, then one can write the equation for its amplitude. The equation for the amplitude is obtained. It portrays a fourfold delta function that takes on an especially direct and simple form. It is derived from the products of causality functions. (TTT)

31102 THE SIGN OF THE CONSTANT OF GRAVITATION. W. H. McCrea (London Univ.). Nature, 206: 553-5(May 8, 1965).

A theory on the sign of the constant of gravitation is presented. The sign of the gravitation constant is stated as being essentially a matter of convention. The constant of gravitation enters into general relativity as a conversion constant: this makes it a constant and nothing else. It is shown that ordinary classical theory or ordinary relativity theory, would admit no difference in gravitational behavior between matter and anti-matter. (P.C.H.)

31103 A POSSIBLE CONNEXION BETWEEN THE GRAVITATIONAL FIELD AND ELEMENTARY PARTICLE PHYSICS. E. T. Newman (King's Coll., London). Nature, 206: 811-12(May 22, 1965).

It is shown that there is some evidence for a group-theoretical connection between the gravitational field and elementary particles. (D.C.W.)

31104 MOTION OF CHARGED PARTICLES IN AXIALLY SYMMETRIC ELECTROMAGNETIC FIELDS

WITH A MEDIAN PLANE. S. Ya. Yavor (Leningrad Inst. of Physics and Tech.). Nucl. Instr. Methods, 34: 341-4(June 1965).

Equations for charged particle trajectories in axially symmetric electromagnetic fields with a median plane are considered. The median plane in this case will be a plane of symmetry for the electric field and a plane of antisymmetry for the magnetic field. It contains only field components $E_r = E(r)$ and $H_z = H(r)$ and hence there will be no force which might drive a particle out of this plane. (C.E.S.)

31105 ANALYSIS OF THE NEW CONSERVATION LAW IN ELECTROMAGNETIC THEORY. D. J. Candlin (Univ. of Edinburgh). Nuovo Cimento (10), 37: 1390-5(June 16, 1965).

The new conserved tensor in electromagnetic theory introduced by Lipkin is shown to be a member of an infinite sequence of moments constructed from the wave vector. The physical interpretation is discussed. (auth)

31106 THE CANONICAL FORM OF INTERACTING GRAVITATIONAL AND SPIN FIELDS. G. Lemmer (Cambridge Univ., Eng.). Nuovo Cimento (10), 37: 1647-58 (June 16, 1965).

A system of interacting gravitational and spin fields is cast into canonical form. The spin tensor of the matter field is regarded as being perfectly general resulting in fairly complicated expressions for the energy- and momentum-density operators. The complexity of these expressions is reduced somewhat by the inclusion of direct spin-spin interaction terms in the lagrangian. A general technique, devised by Schwinger, is employed in evaluating the commutation relations of the spin tensor. (auth)

31107 ON COVARIANT DIFFERENTIATION WITHIN A NULL HYPERSURFACE. G. Lemmer (Cambridge Univ., Eng.). Nuovo Cimento (10), 37: 1659-72(June 16, 1965).

A 4-dimensional Riemannian space-time does not induce sufficient structure on a null hypersurface to enable one to define covariant differentiation within the hypersurface according to the usual procedures of differential geometry. An attempt to provide a definition using basic aspects of the Lorentz group in the spirit of gauge invariance also fails owing to the nonsemi-simple nature of that subgroup of the Lorentz group which preserves a null hypersurface. In order to proceed an assumption is made, familiar in gravitational radiation theory, which eliminates space-times admitting locally cylindrical ray congruences and enables one to provide a rigging of the null surface. A definition of induced covariant differentiation within the null surface follows directly and the Gauss-Codazzi equations are derived. To conclude, a prescription for raising and lowering indices on quantities in the null surface is given. (auth)

31108 A HAMILTONIAN FORMALISM WITH A LINEAR SUPPLEMENTARY CONDITION AND ITS APPLICATION TO FIELD THEORY AND MANY-BODY SYSTEM. Yasushi Takahashi (Dublin Inst. for Advanced Studies). Physica, 31: 205-21(Feb. 1965).

A hamiltonian method with a linear supplementary condition is proposed and is applied to a many-particle system in order to see how the independent particle model can be justified. A particle interacting with a field is also dealt with in terms of this formalism. This formalism is found to be useful to treat systems of many degrees of freedom without destroying the symmetry and the translation invariance. (auth)

31109 DERIVATION OF MAXWELL'S EQUATIONS. THE STATISTICAL THEORY OF THE MACROSCOPIC EQUATIONS. S. R. De Groot (Instituut voor Theoretische Fysica, Amsterdam) and J. Vlieger. Physica, 31: 254-68(Mar. 1965).

The macroscopic Maxwell equations are derived in covariant ways from the "atomic field equations". The latter were themselves obtained previously from the field equations of electron theory for point particles, by means of a covariant multipole expansion. In the statistical derivation an appropriate averaging procedure is used in a so-called "fluxion space"—the space spanned by the atomic positions, the atomic multipole moments, and the first and higher time derivatives of these variables, on which the fields may depend. Retardation of the fields is also taken into account. (auth)

31110 ROTATING FLUID MASSES IN GENERAL RELATIVITY. R. H. Boyer (Univ. of Liverpool). Proc. Cambridge Phil. Soc., 61: 527-30(Apr. 1965).

Some properties of the gravitational field of an isolated, axially symmetric, uniformly rotating mass of perfect fluid in a steady state are derived, according to the general theory of relativity. The vacuum solution of Kerr, possessing features expected of a space-time exterior to some rotating body, is taken into consideration. It is asked whether a perfect fluid interior can be matched to any given exterior field. Main results exhibit the class of all possible fluid boundaries, given the exterior field, and relations between the pressure, density, 4-velocity, and interior metric tensor. (M.J.T.)

31111 AN INTERPRETATION OF THE KERR METRIC IN GENERAL RELATIVITY. R. H. Boyer and T. G. Price (Univ. of Liverpool). Proc. Cambridge Phil. Soc., 61: 531-4(Apr. 1965).

A discussion is given of aspects of the vacuum solution found by Kerr for the exterior field of some rotating body. The behavior of the bounded geodesics (planetary orbits) of the Kerr solution is examined. It is asked what sort of body could be a source of the Kerr field. It appears that one of the parameters in the Kerr solution can plausibly be related to the angular momentum per unit mass of a uniformly rotating sphere, and other parameter being a measure of the mass of the sphere. A derivation is given of the behavior of an orbit lying in the equatorial plane and of the motion of its pericenter. Results are compared with other work. (M.J.T.)

31112 ON THE SOLUTION OF AN EQUATION OCCURRING IN QUANTUM MECHANICS. M. Anthea Grubb (Univ. of Hull, Eng.). Proc. Cambridge Phil. Soc., 61: 535-6 (Apr. 1965).

An equation arising in a study of the evolution of a one-dimensional quantum system is examined: $i\partial\psi/\partial t = \alpha(\phi, \psi)_t\phi + \kappa x\psi$, where α and κ are positive constants, and $(\phi,\psi)_t = \int_{-\infty}^{\infty} \phi^*(x)\psi(x,t)dx$. The equation is transformed into an integral equation and solved by an iteration procedure. It is shown that this system provides an example of a wave packet undergoing exactly exponential decay. (M.J.T.)

31113 STATISTICAL ELECTRODYNAMICS. T. W. Marshall (Univ. of Manchester, Eng.). Proc. Cambridge Phil. Soc., 61: 537-46(Apr. 1965).

A random pure radiation field postulated previously is set up in a relativistically invariant manner. The requirement that this field be isotropic in three dimensions makes much of the formalism identical with the theory of isotropic turbulence. It is found, however, that the more stringent requirement of invariance under the Lorentz group, together with the fact that the field components satisfy Maxwell's equations, means that, to within a multiplicative constant, the entire random process is uniquely specified. This constant is effectively identified as Planck's constant. There then results a striking resemblance between the formalism of the present theory and that of the quantized pure radiation field, with random variables taking the place of operators and correlations between these random variables taking the place of commutator brackets. The infinite field energy, which arises also in quantum field theory, where, however, it is usually considered to be purely formal, remains a central difficulty of the random theory. It can be shown to be a natural consequence of assuming Maxwell's equations, and it therefore becomes necessary to consider nonlinear modifications of these. The connection between the present results and the inconsistencies of classical and quantum electrodynamics is discussed. Also some new information is obtained concerning the behavior of thermodynamic quantities under a Lorentz transformation. (auth)

31114 THE ELECTROMAGNETIC FIELDS OF MOVING DIPOLES. G. N. Ward (College of Aeronautics, Cranfield, Eng.). Proc. Cambridge Phil. Soc., 61: 547-53(Apr. 1965).

Formulas for the fields of moving dipoles were obtained previously in rather different forms by J. R. Ellis and by G. N. Ward; it appears that Ward's results are more general than Ellis's. The results are re-derived from a consideration of the Hertzian six-vector potential for a distribution of moving dipoles, and a comparison is made with the previous forms. It is found that Ellis's results are essentially as general as Ward's. The expressions for the potentials and the field tensors are treated as weak functions in Temple's sense, and very few restrictions have to be imposed on the dipole moments and velocities, which may be expressed either as functions of coordinate time or as functions of proper time. (auth)

31115 ON THE AMBIGUITY OF CUT-OFF PROCESS IN THE THEORY OF QUANTUM FIELD. Tadashige Ishihara (Osaka Univ.). Proc. Japan Acad., 40: 19-22(1964).

The relation between the occupation number representation and the tensor product of Hilbert spaces is considered in an axiomatic manner in order to explain the cut-off procedures used to remove divergences of physical quantities in quantum field theory calculations. The cut-off process is considered in terms of the tensor product, and four examples are presented to show ambiguities of the procedures. (L.B.S.)

31116 ON SOME TOPOLOGIES IN THE UNIVERSAL HILBERT SPACE. Tadashige Ishihara (Osaka Univ.). Proc. Japan Acad., 40: 23-8(1964).

The universality of Hilbert spaces and the relation to the customary occupation number representation is considered. The topology to obtain the new perturbative method between orthogonal spaces is investigated. (L.B.S.)

31117 ON THE CUT-OFF PROCESS IN THE UNIVERSAL HILBERT SPACE. Tadashige Ishihara (Osaka Univ.). Proc. Japan Acad., 40: 734-9(1964).

The problem of using the universal Hilbert space, which may be considered to include all the inequivalent representation spaces, in the treatment of quantum field theoretical problems is investigated. Revised definitions of cut-off operators are introduced, and two methods for introducing topologies—direct and dual space methods—are presented. (L.B.S.)

31118 SPINOR REPRESENTATION OF FIVE-DIMENSIONAL LORENTZ TRANSFORMATION. N. N. Ghosh (Indian Assn. for the Cultivation of Science, Calcutta). Proc. Natl. Inst. Sci. India, Pt. A, 30: 383-94 (May 26, 1964).

In a complex two-dimensional non-analytic manifold S_2, a special (unimodular) complex transformation scheme with regard to "spinors" has been framed. A mixed spinor H^{μ}_{ν} undergoing this transformation is then shown to be associated with a vector h_k undergoing an induced Lorentz transformation in a de Sitter space. One thus obtains the representation of the five-dimensional Lorentz transformation in terms of the complex spinor transformation coefficients. An allied representation by means of real transformation coefficients has also been obtained on replacing the complex mixed spinor H^{μ}_{ν} in S_2 by an "equivalent" real mixed tensor A^{β}_{γ} in the auxiliary four-space R_4. (auth)

31119 SPINNING PARTICLES IN NORDSTRÖM'S THEORY. J. S. Dowker (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 85: 1035-8(May 1965).

The equations of motion of a spinning particle in a conformally flat space-time are derived and applied to Nordström's theory, in which the strong principle of equivalence is found not to hold. (auth)

31120 NOTE ON A PROPOSED EXPERIMENT TO TEST SPECIAL RELATIVITY THEORY. E. N. Bramely (Radio Research Station, Slough, Bucks, Eng.). Proc. Phys. Soc. (London), 85: 1046-7(May 1965).

In a recent proposal for testing the local time effect in special relativity theory, it was stated that if two radio transmitters spaced a fixed distance apart on the ground radiate synchronized signals, an observer moving along an extension of the line joining the transmitters would observe a phase difference between the signals which depends on his velocity. It is shown that this conclusion is incorrect and that special relativity gives the phase difference measured by a moving observer to be exactly the same as for a stationary observer. (D.C.W.)

31121 AN ATTEMPT TO DERIVE THE GRAVITATIONAL POTENTIAL. Kimura, Toshiei (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 33: 510-23 (Mar. 1965).

A model theory is proposed to introduce both the mass of the matter field and the repulsive gravitational potential between matters within the framework of Minkowski's space-time. In consideration of the expansion of the universe, the conformal invariant equations for two coupled scalar fields are taken as starting equations. By two procedures breaking conformal invariance, it is shown that one field is the negative energy field and that the self-consistent mass equations, while they allow zero for the negative energy field, allow a nonzero value for the mass of the other field. The negative energy field, in the energy density, is replaced by the repulsive adiabatic potential with a retardation effect. The transformed energy density does not satisfy the usual equal-time commutator of energy density which is valid for the ordinary system of fields with spin ≤ 1. The additive potential is introduced so that the total energy density satisfies the usual energy density commutator. The total Hamiltonian is shown to be nothing but the one which gives the post-Newtonian equation of Einstein, Infeld and Hoffmann for the two-body problem in general relativity. (auth)

31122 QUANTUM THEORY AND GENERAL RELATIVITY. Utiyama, Ryoyu (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 33: 524-37(Mar. 1965).

A method of establishing a quantum theory of atomic systems interacting with a c-number gravitational field is proposed. This method is a most straightforward generalization of the approach adopted for the representation of the general relativity in terms of the Vierbein. To each world point, a local Hilbert space is assigned. The connection between Hilbert-space defined at a pair of adjacent points is given by an equation with a non-integrable property. This non-integrable equation is discussed. (auth)

31123 COSMOLOGICAL INTERPRETATION OF THE WEAK FORCES. Hayakawa, Satio (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 33: 538-9(Mar. 1965).

The origin of the weak forces is discussed in terms of a universe filled with cold neutrinos of finite mass. It is shown that the zero-point energy of the neutrino gas accounts for the weak forces and that the violation of neutrino-antineutrino symmetry due to the beta decays associated with the stellar energy generation is responsible for the PC non-invariance recently found by the $K^0_2 \rightarrow 2\pi$ decay. (D.C.W.)

31124 GENERATION OF COMBINED MAXWELL-EINSTEIN-KLEIN-GORDON FIELDS FROM PURELY GRAVITATIONAL CASES. De, Nitaichand (Jadavpur Univ., Calcutta). Progr. Theoret. Phys. (Kyoto), 33: 545-6(Mar. 1965).

It is shown that a class of combined Maxwell-Einstein-Klein-Gordon fields can be obtained from purely gravitational cases when the mass parameter equals the magnitude of the charge parameter and the condition $m^2 g_{44} = (E - (4\pi)^{\frac{1}{2}} \epsilon \phi)^2$ between the electrostatic potential ϕ and the component of the metric tensor g_{44} is satisfied. (D.C.W.)

31125 RELATIVITY SINCE EINSTEIN. C. W. Kilmister (King's Coll., London). Sci. J., 1: No. 1, 63-7 (Mar. 1965).

The principles and implications of Einstein's theory of

relativity are outlined; and the difficulties that arise from the theory are discussed in detail, particularly the quantization of the theory. (D.C.W.)

31126 A NOTE ON THE RANDOM PHASE APPROXIMATION AND THE GENERALIZED CONFIGURATION MIXING METHOD. Shi-shu Wu (Kirin Univ., China). Sci. Sinica (Peking), 14: 792-7(May 1965).

It is pointed out that the random phase and higher random phase (RP-HRP) approximation is well established as an approximation of the generalized configuration mixing method if the eigenvalue equation of the RP-HRP approximation can be obtained by the method of Green's functions. The RP approximation for the particle-hole interaction is discussed as an example, and it is further shown that its eigenvalue equation may be rewritten in the form of an ordinary Schroedinger eigenvalue equation. (L.B.S.)

31127 THE HIGHER RANDOM PHASE APPROXIMATION AND THE METHOD OF GREEN'S FUNCTION. Shi-shu Wu (Kirin Univ., China). Sci. Sinica (Peking), 14: 798-802(May 1965).

A method for deriving the eigenvalue equation for the higher random phase approximation by the method of Green's functions, using the contraction approximation, is presented. (L.B.S.)

31128 ON THE EXISTENCE OF PARTICLE—LIKE SOLUTIONS OF EINSTEIN'S EQUATIONS FOR SCALAR COMPLEX FIELD. M. I. Stakvilevichus. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 41-7(Nov.-Dec. 1964). (In Russian)

It was shown that Einstein's equations with energy-momentum tensor for scalar complex fields in the righthand side permit spherically symmetrical solutions in which the metrics have a Schwartschild nature at great distances. In the approximation of weak gravitational fields, the motion of metrics approached the corresponding metrics of Newtonian potentials. The possibility of obtaining the mass spectra of scalar particles with solutions of such equations and with the introduction of scalar quantum quasicharges was indicated. (tr-auth)

31129 ON THE QUASIOPTIC METHOD OF MESON THEORY WITH FIXED SOURCE. V. D. Kukin. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 75-9(Nov.-Dec. 1964). (In Russian)

The quasioptical method in the quantum theory of fields is used for symmetric pseudoscalar meson theory with fixed source (nucleon). The expression for the interaction potential of mesons with nucleons, correct to the terms of the sixth order inclusively, were obtained by dissociation of the renormalization constants for the coupling of meson fields with nucleons. The results agreed with the known numerical solutions of the Chew-Low equations for this theory. (tr-auth)

31130 ETUDE DU CARACTERE COMPLET DE LA THEORIE QUANTIQUE. (Study of Complete Characteristics of Quantum Theory). Mioara Mugur-Schaechter. Les Grands Problemes des Sciences, No. 18. Paris, Gauthier-Villars, Editeur, 1964. 83p.

The Von Neumann theorem on the incompatability with the quantum theory of the existence of hidden parameters associated with microsystems was invalidated. The possibility of solving experimentally the problem of the complete character of the quantum theory was deduced. From the analysis of the quantum measurement processes, the possibility of submitting a microsystem to measurements of a type other than quantum measurements, to nonquantum measurements, was deduced. This possibility is associated with that of experimentally solving the problem of the complete character of the quantum theory. This result transposes the problem of the complete character of the quantum theory from the purely speculative subjective domain, where it now is, to the objective domain. The possibility rests actually on the recording of the trace of a microsystem providing at the same time values possessed at the same instant by the position and quality of movement of this microsystem with the imprecisions to which the uncertainty principle does not apply. It is shown that if this is realized effectively the quantum theory of transformations does not possess a general validity. (J.S.R.)

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Refer also to abstracts 30912 and 31589.

31131 (AD-607814) EXPLORATION OF THE TERRESTRIAL RADIATION BELT. John W. Lindner (Space Technology Labs., Inc., Los Angeles, Calif.). Mar. 18, 1959. 32p. $2.00(CFSTI).

Experimental data from the Explorer-I, -II, and -IV and Pioneer-1, -2, and -3 satellites on the configuration and intensity of the earth's radiation belts are reviewed and summarized. The future experimental program, involving measurements of the intensity and composition of the trapped radiation, is outlined. (M.J.T.)

31132 (AFCRL-64-815) A SUMMARIZATION OF TECHNICAL AND SCIENTIFIC REPORTS ISSUED BY THE IONOSPHERE RESEARCH LABORATORY — PAPERS PRESENTED AND PUBLISHED. Scientific Report No. 200. A. H. Waynick (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Dec. 1, 1963. Contract AF19 (628)-4014. 456p. (AD-607538). $7.55(CFSTI).

References (199) are given to technical and scientific reports on ionosphere research published from 1948 through 1963. Abstracts and summaries for each are included. Also, 190 papers presented at technical and scientific meetings, and 217 papers published as journal, items are listed. A total of 606 references are included. (P.C.H.)

31133 (MIT-2241-4) A MODELING STUDY OF THE MERIDIONAL TEMPERATURE PROFILE AND ENERGY TRANSFORMATIONS IN THE LOWER STRATOSPHERE. Report No. 13. Li Peng (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). Apr. 7, 1965. Contract AT(30-1)-2241. 169p. Dep.(mn); $5.00(cy), 3(mn) CFSTI.

A simplified hemispherical dynamical model was employed to study the meridional temperature profile in the lower stratosphere and its relation to the energy transformations. In a numerical experiment an equator-to-pole temperature increase was produced in the upper layer of the model despite the imposed diabatic heating being poleward-decreasing in each layer. The mean value of the equator-to-pole temperature increase is in agreement with the one observed in the lower stratosphere. The averaged energy flow in the upper layer clearly displays the passive nature of the layer. The eddy kinetic energy appears to be a direct or indirect source of other forms of energy; it is converted into zonal kinetic energy and into eddy available potential energy which in turn is converted into zonal available potential energy. Both the zonal and eddy available potential energy suffer a net adiabatic loss. The eddy kinetic energy is reinforced by vertical transport from below. It was found that the major process directly responsible for the equator-to-pole temperature increase in the upper layer is the up-gradient transport of heat in the layer due to large-scale eddies. It was also found that up-gradient heat transports in the upper layer are simultaneously accompanied by energy conversions from eddy kinetic into eddy available potential energy in the upper layer and also accompanied by the opposite energy conversions in the lower layer. Therefore the equator-to-pole temperature increase in the upper layer is a characteristic of the passive nature of large-scale motions in the layer. Further numerical experiments using a simpler dynamical model were performed to examine how the equator-to-pole temperature increase in the upper layer depends upon the ratio of the imposed thermal Rossby number in the upper layer to the imposed thermal Rossby number in the lower layer. The results indicate that (for other parameters fixed) there exists a critical value of the ratio such that if

the ratio is super-critical no equator-to-pole temperature increase can be maintained in the upper layer. If the ratio is subcritical, the magnitude of the equator-to-pole temperature increase in the upper layer does not seem to depend significantly upon the imposed thermal Rossby number in the layer. (auth)

31134 (NP-14990) VLF PHASE PERTURBATIONS AND THE SOVIET HIGH-ALTITUDE NUCLEAR BURSTS OF OCTOBER 22 AND 28, 1962. 1. OBSERVATIONS AND INFERRED RADIATION BELTS. C. R. Haave, A. J. Zmuda, and B. W. Shaw (Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.). [1964]. 50p.

On October 22 and 28, 1962, nuclear explosions over Central Asia produced ionosphere D-layer perturbations as monitored on various vlf paths in the northern hemisphere. Delayed vlf effects due to trapped particles averaged 53 per cent of the normal diurnal change for the burst of October 22, and 29 per cent for the burst of October 28. The types of particles and their energies were the same for both detonations but differences existed in the spatial extent of the radiation belts producing the vlf phase perturbations. The trapped particles were electrons with $E \lesssim 4$ Mev and protons in the range 2.3 to 4.6 Mev. The electron spectrum was composed of fission and neutron decay betas, with the latter predominating for $E < 0.78$ Mev. Protons < 2.3 Mev may have also been present but those with $E < 1$ Mev can not penetrate into the D-region and are of no direct vlf interest. With the dipole field approximation for the detonation of October 22, it was found that fission and neutron decay betas were trapped in a region bounded by field lines intersecting the earth's surface in a range extending at least from 36.5 to 56° geomagnetic (for the real field the shells are $1.75 \leq L \leq 3.76$). For October 28, fission betas were confined to areas <49°N ($L < 2.32$) and probably to field lines around that passing through the burst point (at 36.5°N and $L = 1.75$); this type of confinement also existed for 2.3- to 4.6-Mev protons after both nuclear bursts. For October 28, effects due to neutron-decay betas were found at 49°–51°N ($2.32 \leq L \leq 2.79$), a region which formed the outer boundary for these trapped particles. For the burst of October 22 a prompt effect was observed on the GBR to APL transmission. (auth)

31135 (UCRL-7495) CHERENKOV ELECTROMAGNETIC RADIATION FROM A NUCLEAR DETONATION IN SPACE. S. A. Colgate and K. S. Yee (Lawrence Radiation Lab., Univ. of California, Livermore). Apr. 23, 1964. Contract W-7405-eng-48. 41p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

It is predicted that a nuclear detonation above the earth's atmosphere will give rise to an electromagnetic pulse that is in phase with the emitted gamma pulse. The maximum electric field at the earth's surface several hundred kilometers from a detonation may reach a limiting breakdown value of 300 v/cm with the electric vector directed opposite to the direction of gamma propagation. The origin of the pulse depends upon the Cherenkov-like radiation from the gamma produced Compton electron distribution moving across the top of the earth's atmosphere at a phase velocity greater than that of light. The time behavior of the pulse in first order is independent of the thickness of the earth's atmosphere in which the gamma rays are absorbed. (auth)

31136 (UCRL-12473(p.64-71)) FLUID AND HYDRODYNAMICS. (Lawrence Radiation Lab., Univ. of California, Livermore).

Research is reported on atmospheric models, numerical ocean models, the zonal two-dimensional weather code ZAM, and a comparison of the performance of the grid and spectral methods of hemispheric weather prediction. (T.F.H.)

31137 (NASA-TT-F-145) GASEOUS COMPOSITION OF THE ATMOSPHERE AND ITS ANALYSIS. B. A. Mirtov. Translation of "Gazovyi Sostav Atmosfery Zemli i Metody Ego Analiza," (a Publication of the Publishing House of the Academy of Sciences, Moscow, 1961). 214p. (OTS-64-11023). CFSTI.

Analyses of the lower and middle atmosphere (up to 30 km) are investigated. Rocket and satellite techniques for analysis and sampling of the chemical and ionic composition of the upper atmosphere are reviewed, with emphasis on Russian measurements. The ozone concentration in the atmosphere is measured. 314 references. (T.F.H.)

31138 THE SUN AND THE IONOSPHERE. J. A. Ratcliffe (Radio Research Station, Slough, Eng.). Advan. Sci., 21: 323-30(Nov. 1964).

The nature of and the means for exploring the uppermost layer (F2) of the ionosphere are reviewed. Its structure is explained by supposing that, above the peak of the layer, the distribution of the electrons is determined jointly by their temperature and by gravitational forces, that below the peak it is determined by the rate at which they disappear by recombination, and that the peak occurs at the level where the two processes balance. Measurements of the electron concentration below the peak, such as can be made from ionosphere sounders on the ground, can provide information about the processes of electron recombination, but little about their temperature or the effects of gravity on them. To investigate these phenomena it is necessary to explore the part above the peak, the topside. The structure of the F2 layer is described schematically by plotting the electron concentration on a logarithmic scale so that an exponential height variation is represented by a straight line. Above the peak of the layer the possibility exists that there might be a mixture of light and heavy ions. This scheme indicates that some knowledge of the ionosphere above the peak of the F2 layer would yield much information about the height distribution of the different atomic gases and about their temperatures. For exploring the topside portion of the ionosphere, the most productive soundings have been made by the satellite Alouette. Another method for investigating the electron distribution on the topside of the ionosphere, by the use of equipment on the ground, employs an intense beam of radio waves which is sent vertically upwards on a frequency great enough to penetrate the ionosphere completely. By these two experimental methods, it is possible to determine the vertical distribution of electrons on the topside of the ionosphere, and then the temperature T or the mass m of the ions which accompany the electrons. T is usually found to be between 1000° and 2000°K. This comparatively great temperature results from the absorption of the u-v radiation which ionizes the atmosphere. How estimates of the temperature of the neutral atmosphere have been made are also described. The effect of the earth's magnetic field on the ionosphere is also discussed. (BBB)

31139 IONIZATION VARIATIONS IN THE IONOSPHERE OF AVERAGE AMPLITUDE AND VARIATION OF THE USEFUL FREQUENCIES IN SHORT-WAVE COMMUNICATION WITH 27-DAY PERIODS AS EFFECT OF SOLAR WAVE RADIATION. Lange-Hesse, Guenther; Schott, Eduard (Max-Planck-Institut fur Aeronomie, Northeim, Ger.). Arch. Elek. Uebertrag., 19: 59-65(Jan. 1965). (In German)

The solar radiation responsible for the production of the ionization in the ionosphere varies in its intensity in close correlation with the period of the 11-years sunspot cycle. Furthermore, intensity variations with a quasi-persistent 27-day period can occur in cases where sunspots are unsymmetrically distributed in heliographic longitude and where the sun, in the course of its rotation in about 27 days exhibits alternatively discs with many spots and with few spots. It is shown that such intensity variations produce considerable 27-day variations with the same phase in the critical frequencies of the F_1-, F_2- and E_1-layers as well as in the MUF3000 (maximum usable frequency for the 3000-km distance), but 27-day variations with reversed phase in the M3000 factor (conversion factor from vertical to oblique-incidence critical frequency for the 3000-km distance). 27-Day quasi-persistent variations in the average temperature of the F-layer may be responsible for the production of these M3000 variations. Numerical data are given for magnitude and seasonal variation of the average

relative amplitude of the 27-day variations of the ionospheric data mentioned above. (auth)

31140 IONIZATION CONDITIONS IN A LIGHTNING CHANNEL IN RELATION TO MULTIPLE STROKES. Jacques Papet-Lepine (Uppasala Univ.). Arkiv Geofysik., 4: 75-81(1963).

An attempt was made to explain the passage of multiple lightning discharges in the same channel. It was admitted that a subsequent stroke meets favorable conditions created by a foregoing discharge. An attempt was therefore made to find the law of evolution of the physical parameters in a lightning channel after the passage of the current. Since the distribution of time intervals between two consecutive lightning discharges is known, it is possible to compare and verify the exactness of the proposed explanation of the residual ionization. An application was made to a concrete case. It was shown that even for a primary lightning discharge of high intensity there can not be new lightning discharges in a channel if the interval between two strokes exceeds 400 milliseconds. This result is confirmed by experience. (auth)

31141 DIFFERENT TYPES OF MUSICAL ATMOSPHERICS AND THEIR RELATIONS TO LIGHTNING DISCHARGES. Edgar Knudsen and Harald Norinder (Uppsala Univ.). Arkiv Geofysik., 4: 83-101(1963).

The recording method at a whistler observation station allowed a correlation between lightning discharges and musical atmospherics produced by them. About 700 musical whistlers collected in 1958–61 were analyzed. It was found that about 70% of the records were correlated to lightning discharges and about 30% were not. With these comparatively extended records as a basis, it was possible to undertake a classification of different types. It was possible to start with fully adequate variational types. Multiples and combinations of the fundamental types were also introduced. The striking resemblance between correlated and non-correlated short-time variational types indicated that variational types that are not correlated must also be emanated from lightning discharges. The combined variational types proved that the wave-packets emitted from the lightning discharges were modified in different ways as to their mode of propagation. (auth)

31142 STUDIES OF AURORAL REFLECTIONS IN THE VHF BAND. I. EXPERIMENTAL INVESTIGATIONS, WITH SPECIAL REGARD TO TIME VARIATIONS, FADING RATE, AZIMUTHAL DISTRIBUTIONS, AND POLARIZATION CHARACTERISTICS. Egeland, Alv (Kiruna Geophysical Observatory, Sweden). Arkiv Geofysik., 4: 103-69(1963).

Oblique auroral echoes on the 90 Mc/s band were studied on the basis of data amassed during four years and five months of continuous recording (January, 1958 to July, 1962) at Kiruna Geophysical Observatory (φ = 67.8° N, λ = 20.4° E). During the last eight months of observation, radio-aurora measurements were recorded simultaneously with a 41.0 Mc/s radar. The results of this investigation of aurorally propagated v-h-f transmissions with respect to time variations (diurnal, day-to-day and seasonal variation), duration, signal strength, fading rate, azimuthal distribution, and auroral reflection polarization characteristics are reported. The correlation with solar and magnetic disturbances as well as that with nondeviative ionospheric absorption and that with visual aurora is also discussed. 100 references. (auth)

31143 STUDIES OF AURORAL REFLECTIONS IN THE VHF BAND. II. COMPARISON OF EXPERIMENTAL RESULTS WITH THEORETICAL MODELS. Egeland, Alv (Kiruna Geophysical Observatory, Sweden). Arkiv Geofysik., 4: 171-209(1963).

A number of auroral reflection mechanisms have been hypothesized by different investigators, the most comprehensive model being that advanced by Booker in 1956. In all previous investigations of auroral reflections, only direct back-scatter has been considered. The various radio-aurora theories are reviewed, and an extension of Booker's weak scatter theory to include oblique reflections is carried out. A theoretical calculation of the geometric configuration of oblique radio-auroral echoes, based on the local magnetic field, is presented. Although, heretofore, only prolate ellipsoid models of auroral ionization irregularities were considered by workers in the field of radio-aurora, this investigation indicates that three-axial ellipsoid irregularities are more consonant with the observed angular distributions of auroral reflections. A magnetic east-west to north-south elongation of the auroral irregularities in the average ratio of 2.5:1 was estimated from the observations, on the basis of an assumed north-south correlation length of 20 cm. From radio-aurora measurements at 40 and 90 Mc/s, the length of the irregularities was estimated at 14 and 8 m, respectively. This implies that the length of the irregularities along the magnetic field lines is not, as previously assumed by Booker and several subsequent workers, constant. It seems reasonable, moreover, to assume that the size, strength and number of irregularities vary within the scattering area and that these properties may be governed by auroral and magnetic activity. 62 references. (auth)

31144 LIGHTNING COUNTERS. I. THE CHANGE IN ELECTRIC FIELD DUE TO LIGHTNING STROKES, WITH REFERENCE TO ITS EFFECT ON LIGHTNING COUNTERS. Mueller-Hillebrand, D. (Uppsala Univ.). Arkiv Geofysik., 4: 247-69(1963).

If the change of the electric field with time is calculated in the conventional way from the current moment of a dipole, its derivative and its time integral, an expression is obtained which is determined by the lightning current, the particular length of stroke, the speed of the stroke and the variation with time of the current. But a closer study of the electric field must be based on a statistical treatment of data obtained from measurements. Measurements in Sweden and in Tessin (Switzerland) gave in the case of earth strokes a wide agreement with the time variation of the field obtained by calculation. Inter alia, oscillograms of multiple strokes are shown, in which 14 partial strokes within 635 ms and 7 partial strokes within 510 ms were measured at a distance of 5 km with sudden jumps in field of several 100 v/m. The first sudden jump in the field within 3 μs repeats with astonishing regularity, even in detail. The cloud strokes are divided into 3 groups: comparatively slow changes within 3 to 300 ms and more, rapid changes within 50 μs to 500 μs and very rapid pulses within 10 or 20 μs. An analysis of 4761 oscillograms of the electric field during 24 thunderstorms at a distance up to about 20 km from the measuring position in Tessin gave 76.6% cloud flashes and 23.4% earth flashes—a numerical ratio 3.26. This number may vary to a considerable extent from one thunderstorm to another. Measured limits were 0.69 and 165—thunderstorms with a majority of earth flashes and thunderstorms with cloud flashes exclusively. In Uppsala 1.87 times more cloud flashes than earth flashes were measured in four thunderstorms. The intensity of lightning storms in Uppsala (Sweden) was about 5 times less than in Tessin (Switzerland) during 1961. In Uppsala 12.5 flashes to earth and in Tessin 66 flashes to earth during one hour of thunderstorm. (auth)

31145 SATELLITE SCINTILLATION OBSERVED IN THE AURORAL ZONE. Liszka, Ludwik. Arkiv Geofysik., 4: 211-25(1965).

Satellite scintillation studies carried out at Kiruna Geophysical Observatory at frequencies 20 and 54 Mc/s during the last three years are reviewed with emphasis on the 54 Mc/s results. Studies of diurnal and seasonal variations of scintillation at 54 Mc/s show that the shape of the diurnal curve is dependent on magnetic activity and that seasonal variations are not important. The depth of scintillation at 54 Mc/s is better correlated with magnetic activity than at 20 Mc/s. There exists a difference between daytime and night-time scintillation, which is indicated by differences in correlation with auroral sporadic E and with magnetic activity. (auth)

31146 A STUDY OF IONOSPHERIC IRREGULARITIES USING SATELLITE TRANSMISSIONS AT 54 Mc/s. Liszka, Ludwik (Kiruna Geophysical Observatory, Sweden). Arkiv Geofysik., 4: 227-46(1965).

A statistical analysis of the diffraction pattern produced by radio waves from artificial satellites is presented. The most important result is the evidence that auroral zone scintillation may be produced at altitudes below F-maximum. Low altitudes, down to 100 km, of the scintillation-producing region occur more frequently during night-time. During the forenoon hours, when some of the measurements were made, the scintillation was produced at or above F-maximum. Investigation of the shape of ionospheric irregularities have shown that if it is assumed that they are two-axial ellipsoids orientated along the magnetic field lines, axis ratios of order of magnitude 10 will be obtained. (auth)

31147 SOME DIFFERENT TYPES OF WHISTLERS IN RELATION TO SIMULTANEOUS THUNDERSTORM ACTIVITY. Norinder, Harald; Knudsen, Edgar (Uppsala Univ.). Arkiv Geofysik., 4: 333-43(1965).

An investigation was carried out in order to compare some different types of whistlers and their relations to thunderstorm activity. It was found that the same thunderstorm region produced usual as well as unusual and mixed variational forms of whistlers. The production of the different types proved to be independent of the geographical positions of the active thunderstorm regions. By the aid of different characteristics of lightning discharges, it was not possible to draw conclusions as to why different types of whistlers were produced. The reason must be sought in some other geophysical phenomena, and only further systematic experimental investigations will give an answer to this question. (auth)

31148 A COMPARISON OF AURORAL LUMINOSITY AND IONOSPHERIC ABSORPTION USING WIDE-ANGLE MEASUREMENTS. Brown, R. R.; Barcus, J. R. (Univ. of California, Berkeley and Kiruna Geophysical Observatory, Sweden). Arkiv Geofysik., 4: 395-403(1965).

A comparison of auroral luminosity variations over the antenna pattern of the 27.6 Mc/s riometer at College, Alaska, with ionospheric absorption records indicates that ionospheric absorption is associated principally with the post-breakup phase of auroras. The lack of visible structure to the diffuse post-breakup aurora suggests that the fluctuations in the relation between auroral absorption and geomagnetic disturbance, as well as auroral luminosity and ionospheric absorption, are due to differences in the electron energy spectrum from event to event rather than spatial structure of the particle bombardment. (auth)

31149 FEATURES OF THE AURORAL ELECTRON ENERGY SPECTRUM INFERRED FROM OBSERVATIONS OF IONOSPHERIC ABSORPTION. Brown, R. R. (Kiruna Geophysical Observatory, Sweden and Univ. of California, Berkeley). Arkiv Geofysik., 4: 405-26(1965).

An investigation of the energy spectrum of auroral electrons was carried out using geophysical data as a guide. It is shown that an exponential energy spectrum, $N(\geq E) = A \exp(-E/\beta)$, is consistent with experimental data if the characteristic energy β is less than or equal to 10 kev. Exponential spectra with larger β, or power-law spectra, give absorption magnitudes and day-night ratios which exceed experimental values obtained from riometer observations. In addition, it is shown that the ionospheric absorption resulting from electron bremsstrahlung is at least one order of magnitude less than from direct collision ionization. (auth)

31150 AURORAL ZONE FARADAY ROTATION STUDIES. Liszka, Ludwik (Kiruna Geophysical Observatory, Sweden). Arkiv Geofysik., 4: 427-44(1965).

The analysis of 20 months of Faraday rotation observations made at Kiruna Geophysical Observatory ($\varphi = 67.8°$ N, $\lambda = 20.3°$ E) was carried out with emphasis on the special properties of the auroral F-region, especially the geomagnetic field and variations in the total electron content. It was found that the direction of the horizontal component of the geomagnetic field in the F-region differs by about 6° from that extrapolated from the components at ground level. Increases of the rate of Faraday rotation observed in the auroral zone were explained in terms of large horizontal variations of the total electron content. It was found that the amplitude of these variations is about one order of magnitude larger than those observed at middle latitudes. (auth)

31151 DEPENDENCE OF AURORAL ZONE SATELLITE SCINTILLATION ON GEOMAGNETIC ACTIVITY. Liszka, Ludwik (Kiruna Geophysical Observatory, Sweden). Arkiv Geofysik., 4: 445-52(1965).

The dependence of auroral zone satellite scintillation on geomagnetic activity is discussed. It is shown that the scintillation phenomenon depends both on the time of observation and on magnetic activity so that the scintillation index S has to be considered as a function of two variables: the geomagnetic K-index and the time of observation. The shape of this function of two variables may be explained by assuming diurnal changes in the scintillation rate spectrum. (auth)

31152 THE GEOGRAPHICAL DISTRIBUTION OF SATELLITE SCINTILLATION ACTIVITY ABOVE NORTHERN SCANDINAVIA. Liszka, Ludwik (Kiruna Geophysical Observatory, Sweden). Arkiv Geofysik., 4: 453-63(1965).

The geographical distribution of scintillation activity above northern Scandinavia is studied. The apparent agreement obtained between contours of constant scintillation activity and lines L = const. may be interpreted in terms of a connection between the scintillation phenomenon and the radiation belt. (auth)

31153 TRANSIT ACCELERATION OF CHARGED PARTICLES IN AN INHOMOGENEOUS ELECTROMAGNETIC FIELD. C. S. Shen (Purdue Univ., Lafayette, Ind.). Astrophys. J., 141: 1091-1104(Apr. 1, 1965).

The transit acceleration of charged particles when they pass through a time-varying inhomogeneous magnetic field is discussed. Detailed calculations are carried out for cases when the varying field is small compared to the homogeneous field. The first-order effect of the varying field causes diffusion of particles in the phase space. The net energy gain is proportional to the square of the field intensity. When the characteristic frequency of the field is small compared to the cyclotron frequency of the particle, the energy gain of the particle is proportional to the energy of the particle itself. For fast varying fields, the dependence becomes implicit. Unlike the Fermi mechanism, the transit acceleration depends very little on the displacement velocity of the fields. It accelerates electrons more effectively than it does ions. The efficiency of this mechanism is discussed. The magnetosphere is chosen as the background because of the availability of relatively reliable data obtained. It is found that a 10-kev electron may increase its energy to 100 kev within a few hours through the enhanced random-walk process. (auth)

31154 INSTITUTE OF GEOPHYSICS OF PERU. Alberto Giesecke (Instituto Geofisico del Peru, Huancayo). Ciencia Interam., 3: 3-9(May-June 1962). (In Spanish)

Research programs being conducted at the Institute, located at 3315-m altitude in the Peruvian Andes, are discussed, including studies of cosmic radiation, ionospheric absorption of radiation, and geophysics. (BBB)

31155 SOME RESULTS OF RADIOWAVE ABSORPTION MEASUREMENTS IN THE IONOSPHERE. Yu. S. Korobkov (Gor'kii State Univ., USSR). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 186-8(1965). (In Russian)

Preliminary results of an investigation of the passage of cosmic radio emission at frequencies 5.7 to 6.3 Mc through the ionosphere are presented. These measurements were made in Gor'kii (Zimenka) in 1961–1964. The radio signals were received with a horizontal in-phase antenna, whose principal pattern lobe was in the direction of the zenith and measured 25° × 35° at the half-power points. The signal from the antenna was fed to a receiver

with a 1-kc bandwidth and a noise limiter through a four-conductor feeder. A distinguishing feature of the reception was a strong noise background, occurring at 17–21 hours local time, strong enough to suppress the entire signal despite the limiter. The noise of atmospheric origin was observed also during daytime hours, but not during the night. The resultant daily variation is shown and indicates a maximum occurring when the plane of the galaxy goes through the antenna directivity pattern. The seasonal dependence of the absorption is shown. The difference between the average daytime and nighttime levels amounts to about 1.5 db. The results of the seasonal study indicate that an appreciable contribution of the absorption is made by the D layer of the ionosphere. (ATD)

31156 THE MOTION OF PARTICLES OF VARIOUS ENERGIES IN A ROTATING MAGNETOSPHERE. V. P. Shabanskii. Kosmich. Issled., 3: 221-30(Mar.-Apr. 1965). (In Russian)

A change in the solar wind and the extension of the magnetosphere to the night side of the earth cause a transfer of force lines of the geomagnetic field to the night side. In the model considered, the magnetosphere is divided into layers A and B, of which the B layer is marked the tail because of its great rarefaction on the night side. On the day side, the B layer is condensed, and it protects the A layer from solar winds. The drift of magnetic force lines, caused by plasma particles of the magnetosphere, occurs more rapidly than the drift of the whole magnetic field because the force lines are connected with the earth through the ionosphere. An increased intensity of solar winds compresses the magnetosphere without a change in the distribution of force lines in the A and B layers. A new distribution of force lines in the A and B layers occurs under the action of hydrodynamic perturbations when part of the force lines is pushed from B to A layer, and the auroral belt is transferred to higher latitudes. Magnetograms of storms with sudden commencement show a slow increase of the field intensity in the beginning. Solar winds cause the transfer of force lines from A to B layer. This transfer is connected with induction currents in the ionosphere which originate magnetic oscillations with large amplitudes on the earth's surface. On the morning side of the magnetosphere, force lines rotate in the direction of the frictional action of solar winds; and on the evening side, the inverse is the case. (ATD)

31157 USE OF ARTIFICIAL SATELLITES AND ROCKETS TO MEASURE THE X-, Y-, Z-COMPONENTS OF THE GEOMAGNETIC FIELD. A. D. Shevin. Kosmich. Issled., 3: 231-6(Mar.-Apr. 1965). (In Russian)

The northern X-, eastern Y-, and vertical Z-components of the geomagnetic field are measured with a magnetometer mounted on a probe of triaxial orientation system. This is connected to a rocket or satellite in a polar or equatorial orbit. At other angles of orbit inclination to the terrestrial equator, X-, and Y-components must be reduced according to formulas for the deflection angle. When no orientation system of the satellite is used, the reduction can be done by using spherical trigonometric formulas to compute angles between the directions of the satellite and the earth, the satellite and the sun, and the satellite and the vector of the geomagnetic field. The magnetometer mounted on the satellite measures the total vector of the magnetic field. The X_0- Y_0-, and Z_0-components of the reduced system can be computed from the measured scalar value of the intensity of the total field, using cosine formulas. These components can be transformed into components oriented in geographical directions. (ATD)

31158 INVESTIGATION OF SCATTERED ULTRAVIOLET RADIATION IN THE UPPER ATMOSPHERE OF THE EARTH. II. MEASUREMENTS OF SCATTERED L_α-RADIATION IN THE UPPER ATMOSPHERE AT ALTITUDES UP TO 500 KM. V. V. Katyushina and V. G. Kurt. Kosmich. Issled., 3: 243-7(Mar.-Apr. 1965). (In Russian)

In 1963 measurements of scattered L_α-radiation were carried out by means of geophysical rockets in three flights. The container axis during the first flight was pointed towards the zenith. During the second and third flights the container axis rotated describing an arc of 180° which passed through the nadir, the west and the zenith. Two counters were used; the signal of the one counter characterized the radiation of the OI triplets, and the signal of the second counter related the total of radiations in OI and L_α lines. During the first flight measurements were made on the whole trajectory beginning at 120 km in the ascent and finishing at 80 km in the descent. During the second and third flights measurements were made only to a height of 250 km. Absolute values of the radiation intensity from all measurements were obtained: for the first flight, 3.2 kR (coefficient reading); for the second flight, 4 kR; and for the third flight, 0.8 kR. (ATD)

31159 INVESTIGATION OF SCATTERED ULTRAVIOLET RADIATION IN THE UPPER ATMOSPHERE OF THE EARTH. III. MEASUREMENTS OF THE INTENSITY OF THE AIRGLOW IN THE UPPER ATMOSPHERE IN TRIPLET LINES OF OI ($\gamma \approx 1300$ Å) AT HEIGHTS OF 100-500 KM. V. V. Katyushina. Kosmich. Issled., 3: 248-51 (Mar.-Apr. 1965). (In Russian)

Three geophysical rockets were launched in 1963 at times when the sun was either low on the horizon or beneath the horizon. The rockets were equipped with two photon counters and a speed counter. Graphs of the data recorded for ascending and descending flight were obtained, indicating the change of airglow intensity. The maximum airglow intensity was recorded at a height of 200 km. The intensity became constant above 400 km. Records of the intensity differ slightly on both the ascending and descending rocket trajectories. The airglow intensity recorded depended upon the direction of the probe's axis. At a height of 120 km, the intensity at the zenith was ten times that at the nadir. Both the zenithal distance of the sun and the height affected the maximum airglow intensity. (ATD)

31160 INVESTIGATION OF SCATTERED ULTRAVIOLET RADIATION IN THE UPPER ATMOSPHERE OF THE EARTH. IV. TOWARD A THEORY OF RESONANT SCATTERING OF L_α-RADIATION IN THE GEOCORONA. S. A. Kaplan and V. G. Kurt. Kosmich. Issled., 3: 251-6 (Mar.-Apr. 1965). (In Russian)

A simple calculation is given for the intensity of resonantly scattered radiation in the L_α line in the earth's upper atmosphere for various zenith distances of the sun. The result agrees well with observational data. (auth)

31161 INVESTIGATION OF SCATTERED ULTRAVIOLET RADIATION IN THE UPPER ATMOSPHERE OF THE EARTH. V. INTERPRETATION OF OBSERVATIONS OF THE OI (γ 1300 Å) TRIPLET IN THE UPPER ATMOSPHERE. S. A. Kaplan and V. G. Kurt. Kosmich. Issled., 3: 256-61(Mar.-Apr. 1965). (In Russian)

For purposes of studying the change of airglow intensity with height, the whole atmosphere is divided into two layers. The lower layer extends up to 225 km. The other layer consists of the upper part of the atmosphere, in which the absorption of the molecular oxygen may be neglected. In this layer the dispersion is invariable. In the lower layer the albedo changes with height. Optical instruments measure the spectrum integral radiation, which may be compared with the intensity of radiation expressed theoretically. The integral radiation may be compared with the growth curve. Special formulas were developed for computing the integral radiation for Doppler contours. A transit from Doppler contours to Lorentz contours makes it possible to compute changes of intensity with height. A table of the computation results is given; the maximum intensity occurs at 180 km. (ATD)

31162 IONOSPHERIC WINDS AND FEATURES OF CHARGED-PARTICLE DISTRIBUTION IN THE GEOMAGNETIC FIELD. V. I. Krasovskii. Kosmich. Issled., 3: 334-6(Mar.-Apr. 1965). (In Russian)

A theory is outlined in which the distribution of charged particles trapped in the geomagnetic field is affected by ionospheric winds blowing toward the east. (D.C.W.)

31163 THE DYNAMICS OF THE GEOMAGNETIC TRAP AND THE ORIGIN OF THE RADIATION BELTS AROUND THE EARTH. V. D. Pletnev, G. A. Skuridin, V. P. Shalimov, and I. N. Shvachunov. Kosmich. Issled., 3: 336-40(Mar.-Apr. 1965). (In Russian)

The boundary of the magnetosphere created by the interaction between the solar wind and the geomagnetic field reaches a distance of 10 terrestrial radii on the day side of the earth. Electric currents on the boundary increase the magnetic field there. On the night side the magnetosphere is very extended. A particle may pass through the boundary of the magnetosphere because of a radial drift of the particle in an asymmetric magnetic field. The physical processes are studied in a magnetic field from parallels ±70°. The regions permitting and prohibiting particle motion are determined, following Stormer's theory. Boundary currents diminish the magnetic field at neutral points. This effect shows up in the beginning of a magnetic storm. The combination of the current field and the dipole serves to straighten the force lines in the magnetosphere and stretch them towards the solar wind. The proton belt is nearer the earth than the electron belt. (ATD)

31164 PROPAGATION OF RADIO WAVES IN A MOVING SPACE PLASMA. M. A. Gintsburg. Kosmich. Issled., 3: 340-2(Mar.-Apr. 1965). (In Russian)

The propagation of radio waves in the plasma moving around the earth is investigated theoretically. A plasma layer with current is considered, together with radio emission from shock waves in the magnetosphere. An explanation for the charged-particle distribution in the magnetosphere is outlined. (D.C.W.)

31165 ELECTRON DENSITY IN THE WHISTLER MEDIUM. J. O. Thomas (Ames Research Center, Moffett Field, Calif. and Stanford Univ., Calif.) and S. W. Dufour. Nature, 206: 567-71(May 8, 1965).

Theoretical models for the abundance of H^+ at 1,000 km are presented, which, together with the Ariel and Alouette data, resolve the discrepancy between experimental and theoretical electron density profiles in the whistler medium. The proton abundance at 1,000 km is required to decrease rapidly in moderately high latitudes. (D.C.W.)

31166 SOLAR PLASMA WIND, EARTH CURRENTS AND DIURNAL MAGNETIC-FIELD VARIATIONS. H. Poeverlein (Air Force Cambridge Research Labs., Bedford, Mass.). Nature, 206: 604-5(May 8, 1965).

The magnetic-field variations resulting from interaction of the solar wind with the magnetosphere were investigated, with consideration of the effect of a current system in the surface layer of the Earth. The results indicate that Earth currents, which are a consequence of the electric field in the moving magnetosphere, lead to a significant enhancement of the variations. A land-sea effect in the variations was also considered. (D.C.W.)

31167 DIURNAL VARIATION OF TOTAL ELECTRON CONTENT OF THE IONOSPHERE OVER NAIROBI. A. N. Hunter, A. R. Webster, R. F. Kelleher, and R. E. Miall (Univ. of East Africa, Nairobi, Kenya). Nature, 206: 920-1(May 29, 1965).

Preliminary values are presented for the diurnal variation of the total electron content $T = \int Ndh$ for the months of Oct., Nov., Dec. 1964, and Jan. 1965, and these values are compared with median values of $(foF2)^2$ obtained from routine vertical incidence soundings at the same station, Nairobi. Due to the rate of precession of the plane of the satellite orbit, the foregoing period of observations represents approximately one complete cycle of I with local time. (P.C.H.)

31168 HIGH-ALTITUDE EXPLOSION EFFECTS ON 2400-2500 c/s SFERICS. Calvin R.Graf. Proc. IEEE (Inst. Elec. Electron. Engrs.), 53: 528(May 1965).

Some effects of the nuclear explosion of July 9, 1962, on sferics at 2400 to 2500 c/s are summarized. (D.C.W.)

Low Temperature Physics

Refer also to abstracts 30629 and 30743.

31169 (LA-DC-7026) THE ELECTRICAL CONDUCTIVITY OF SOME CRYOGENIC FLUIDS. Walter L. Willis (Los Alamos Scientific Lab., Univ. of California, N. Mex.). 1965. Contract W-7405-eng-36. 91p. Dep. (mn); $3.00(cy), 2(mn) CFSTI.

Thesis submitted to Univ. of New Mexico, Albuquerque.

Measurements of the electrical conductivity of several cryogens were made to determine under what conditions, if any, cryogens could present an electrostatic potential hazard. Apparatus was designed and fabricated which could condense and hold a sample of the cryogen under investigation for a period of several hours. This sample volume incorporated paths for electrical conduction through the cryogen. An equation was derived for the resistivity of the material contained in the sample volume in terms of the geometry and the resistance measured through the sample material. Correction for fringing fields was made by comparison of the calculated and the measured capacitance of the system. The resistance was measured by two methods: the measurement of the current produced by a known potential difference, and the measurement of the decay of an applied charge. Measurements were made on six cryogens. These were liquefied hydrogen, deuterium, argon, nitrogen, carbon monoxide, and chlorotrifluoromethane. The resistivity or conductivity of the cryogens appears to be a function of the applied voltage gradient. In other words, the cryogens tend to act as constant current sources. Electrometer amplifier data from the first method indicated a resistivity range of 5.75×10^{15} ohm-cm at 245 volts/inch for deuterium to about 10^{20} ohm-cm at the same gradient for carbon monoxide. Electrostatic voltmeter data from the second method agreed to with a factor of four for the four most conductive cryogens with poorer agreement in the cases of the two least conductive fluids. It is postulated that cryogens are intrinsically perfect insulators. Observed conduction is believed to be due to the presence of charge carriers produced by ionizing radiation present as natural background. In the case of deuterium, the presence of tritium as an impurity in a concentration of about one part per billion produced enough radiation to make quantitative calculations possible and good support for this hypothesis was obtained. A calculation for the remaining cryogens, based on a reasonable assumption of local cosmic ray activity, indicates sufficient energy availability to account for the observed currents. (D.L.C.)

31170 EQUATIONS OF GINZBURG-LANDAU IN THE VARIABLE REGION. J. Ruefenacht (Battelle Memorial Inst., Geneva). Phys. Letters, 15: 298(Apr. 15, 1965). (In French)

The Ginzburg-Landau equation for the Gibbs' potential of a superconductor is generalized to the case in equilibrium. In the expression for the current, the contribution of the normal electrons is taken into account in the case of a variable field. The equation system derived can be used to consider qualitatively the production of harmonics. (J.S.R.)

31171 PHENOMENOLOGICAL THEORIES OF SUPERCONDUCTORS OF TWO TYPES AND THEIR VALIDITY LIMITS. W. Klose (Siemens-Schuckert-Werke AG., Erlangen, Ger.). Phys. Status Solidi, 9: 295-321(1965). (In German)

The phenomenological theories of superconductors are reviewed. Discussions are presented on the microscopic theory of types I and II superconductors; thermodynamics, electrodynamics, and general phenomenology Ginzburg-Landau (GL) and Bardeen theories; negative phase-boundary-layer-energy; entensions and improvements of the GL-B theory, Abrikosov solution to the GL equation; and transport current, critical field, and magnetization for the Abrikosov state. (L.B.S.)

31172 A SIMPLE MODEL FOR THE MAGNETIC BEHAVIOUR OF SUPERCONDUCTORS WITH AN ANCHORED FILAMENT STRUCTURE. L. N. J. De Jong and B. S. Blaisse (Laboratorium voor Technische Natuurkunde, Delft, Holland). Physica, 31: 317-25(Mar. 1965).

A model of rigorously pinned superconducting filaments is described, permitting the calculation of the complete hysteresis curve of a superconducting rod in a longitudinal magnetic field up to fields where all superconductivity has been destroyed. The results are compared with experiments; alloys with precipitates agree better with the model than homogeneous cold-worked alloys. (auth)

31173 A MODEL FOR THE CRITICAL CURRENTS THROUGH SUPERCONDUCTORS WITH AN ANCHORED FILAMENT STRUCTURE. B. S. Blaisse and L. N. J. De Jong (Laboratoriuum voor Technische Natuurkunde, Delft, Holland). Physica, 31: 326-32(Mar. 1965).

The model of rigorously pinned superconducting filaments described in the preceding paper is adapted to the calculation of the critical current as a function of the applied magnetic field. Different results are obtained for different sponge structures of the filaments. Critical currents are calculated for magnetic fields parallel and perpendicular to the axis of the rod for three filament distributions and orientations. (auth)

31174 ON DISSIPATIVE PHENOMENA IN THE MIXED SUPERCONDUCTIVE STATE. C. J. Gorter (Kamerlingh Onnes Lab., Leiden). Physica, 31: 407-12(Mar. 1965).

If only very weak spatial variations of the free energy, the coherence parameter, or the penetration depth occur, then the Fourier components of period equal to, or almost equal to, the period of the mixed structure will determine the magnitude of the critical current. At higher currents the mixed structure will slip in the direction of the Lorentz force, and a resistance will appear due to electric and ultra-acoustic losses. Ultrasound should be emitted mainly as shear waves almost perpendicular to the direction of motion. In case of pronounced local irregularities, pinning of flux bundles and local readjustment of the mixed structure will give rise to the phenomena observed and analysed by Kim and Anderson. Readjustment in large regions leads to flux jumps. Such jumps may occur when the magnetic enthalpy in certain regions has become larger than the energy in the normal state. Such flux jumps will be rare near T_c, H_{c1} and H_{c2}. Annihilation of opposite fluxes may give rise to large temperature jumps. (auth)

31175 MEASUREMENT OF THE FORCES APPLIED BY A MAGNETIC FIELD UPON A SUPERCONDUCTOR. Jean-Claude Prin. Rech. Aerospatiale, No. 103, 37-45 (Nov.-Dec. 1964). (In French)

It is found that the determination of the forces applied by a magnetic field upon a superconductor is rather difficult except in some cases particularly simple. Measurements were carried out by means of a strain-gage dynamometer at 4°K. They were compared to theoretical results in the case of some extremely simple configurations constituted by plane circuits acting upon a plane superconductor. (auth)

31176 SUPERCONDUCTIVITY OF PLATINUM METAL. Kurt Ulmer (Technische Hochschule, Karlsruhe, Ger.). Solid State Commun., 2: 327-9(Nov. 1964). (In German)

Up to the present Ir is the only superconductor of the four platinum metals Ir, Rh, Pt, and Pd. This was explained as a result of the BCS theory with a low density of states of Rh, Pt, and Pd on the Fermi boundary. The necessary densities of state were taken from measurements of x-ray isochromates. (tr-auth)

31177 ENERGY STATE DENSITY OF SUPERCONDUCTORS WITH PARAMAGNETIC IMPURITY ATOMS IN RELATION TO THE TEMPERATURE. K. H. Bennemann (Technische Hochschule, Karlsruhe, Ger.). Z. Physik, 185: 331-5(1965). (In German)

The density of states of a superconductor was determined for various concentrations of paramagnetic impurities at various temperatures. (auth)

31178 TEMPERATURE DEPENDENCE OF THE SURFACE UPPER CRITICAL FIELD OF SUPERCONDUCTING ALLOYS. G. Ebneth and L. Tewordt (Universitat, Hamburg). Z. Physik, 185: 421-5(1965).

The temperature dependence of the surface upper critical field, H_{c3}, near T_c is calculated for arbitrary values of the mean free path l by taking into account the fourth-order term of the generalized Ginzburg-Landau theory. For finite l the boundary condition is modified such that the normal derivative of the energy gap at the surface becomes positive. The slope of the curve H_{c3}/H_{c2} versus $t = T/T_c$ at $t = 1$ is found to decrease monotonously from zero to −1.040 as one goes from the dirty to the clean limit. (auth)

31179 ON THE POSSIBILITY OF SUPERCONDUCTIVITY IN THIN NON-METALLIC FILMS. B. A. Tavger and V. Ya. Demikhovskii. Zh. Eksperim. i Teor. Fiz., 48: 748-50(Feb. 1965). (In Russian)

The reduction of a three-dimensional Brillouin zone to a two-dimensional zone can lead to conditions where only a single cross section of the Brillouin zone is populated at low temperatures and low carrier concentration. The temperature conditions for a superconducting film are fulfilled for thicknesses less than 10^{-5} cm. The conditions limiting the carrier concentration should have the following form: $N < A/(2\lambda)^3$. Here A is a dimensionless multiplier equal to about 10 for an isotropic quadratic dispersion relation, and λ is the film thickness. An expression is obtained for the tunneling energy that is similar to the tunneling in a massive sample but with a different density of energy states. It can be concluded that a substance with $g > 0$ can become superconducting even at very low carrier concentrations if the film is sufficiently thin. (TTT)

31180 HYDRODYNAMIC THEORY OF COLLECTIVE OSCILLATIONS OF VORTICES IN SECOND-TYPE SUPERCONDUCTORS. A. A. Abrikosov, M. P. Kemoklidze, and I. M. Khalatnikov (Inst. of Problems in Physics and Inst. of Physics, Academy of Sciences, Georgian SSR). Zh. Eksperim. i Teor. Fiz., 48: 765-7(Feb. 1965). (In Russian)

An eddy current can be considered as a singularity in the field equations. A replacement for the London equation is written, and an additional equation is added for the alternating field by analogy between a London superconductor and the superfluidity of a liquid. The superfluid flow of a liquid is described with addition of a term corresponding to the friction, which is proportional to the current. If the collective oscillations propagate along the z axis, the final equations and Maxwell's equations give the following dispersion relation: $\omega = (\pm 1 - i\alpha)\Omega_0\delta^2k^2/(1 + \delta^2k^2)$. Here $\Omega_0 = eH/Mc$. These waves are circularly polarized. The propagation of undamped transverse waves is not possible. The principal dissipation mechanism at low temperatures is by reaction with lattice defects. (TTT)

31181 THIN FILMS AND SURFACE PROPERTIES. Bernard Serin (Rutgers State Univ., New Brunswick, N. J.). 16p. (CONF-640803-4)

From Conference on the Physics of Type II Superconductivity, Cleveland.

Some recent experimental and theoretical observations on surface effects are reviewed, including the results of some measurements on In, Sn, and In–Sn films. (D.C.W.)

31182 IONS IN ROTATING He II: SOME EXPLORATORY EXPERIMENTS. D. J. Tanner, B. E. Springett, and R. J. Donnelly (Univ. of Chicago). 8p. (CONF-651-88)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

An experimental facility for studying rotating helium II is described, and some measurements on the absorption and motion of ions in rotating helium II are summarized. (D.C.W.)

Neutron Physics

See *also* REACTOR TECHNOLOGY — Criticality Studies.

Refer also to abstract 30895.

31183 (AECL-2212) ENGINEERING CHALLENGES IN ING. W. A. Wolfe (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1965. 14p. (CONF-650515-1). Dep.; $0.50(AECL).

From International Conference and Exhibition of the Canadian Nuclear Assoc., Quebec, Canada.

The Intense Neutron Generator (ING) is designed to produce a neutron flux of 10^{16} n/cm^2/sec. Bismuth bombarded by 1-Bev protons yields about 20 neutrons per proton with a heat output of 23 Mev/neutron. A circulating liquid bismuth target will dissipate about 34 Mw of heat. To produce the beam protons are accelerated in a separated orbit cyclotron. The 65 mamp current requires about 70-75 Mw of r-f power (50-200 Mc), which must be generated and transmitted efficiently. In ING precise magnet fields, resonating-cavity electric fields, and well maintained vacuum (10^{-6} torr) place demands on most of today's engineering technology. (auth)

31184 (AP-Note-371) EXPERIMENTAL AND THEORETICAL ANALYSIS OF THE INTEGRATED FAST NEUTRON FLUX IN THE SM-1. E. F. Clancy and D. N. Ferguson (Alco Products, Inc., Schenectady, N. Y. Nuclear Power Engineering Dept.). July 21, 1961. Contract AT (30-1)-2639. 44p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

In order to properly assess structural damage within a reactor, it is necessary that a detailed knowledge of both the spatial and energy dependence of neutron fluxes be known. Accordingly, two calculational models are being used to determine structural damage: PDQ, a few-group two-dimensional code that gives fluxes at any desired point within the reactor; and PIMG-2, a multigroup one-dimensional code that gives the energy-dependent flux within the reactor. To supplement the calculational models, a series of flux measurements using threshold detectors is being carried out at the ALCO critical facility. The results of the experimental measurements and calculational models are discussed in this report. (auth)

31185 (AP-Note-422) SPATIAL AVERAGES OF DIFFUSION COEFFICIENTS. R. L. Murray (Alco Products, Inc., Schenectady, N. Y. Nuclear Power Engineering Dept.). June 20, 1962. Contract AT(30-1)-2639. 24p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The method of forming the average macroscopic absorption cross section for a set of regions is unambiguous, using the criterion of equal total absorption for the system in its heterogeneous and homogeneous states. The correct criterion for the case of transport cross section Σ_t or diffusion coefficient D is not obvious, since these parameters refer to neutron flow, not absorption. Analysis is presented for a simple geometry for which the answer may be found exactly, and various logical criteria are tested against the known result. (auth)

31186 (AP-Note-440) CALCULATION OF GROUP DIFFUSION COEFFICIENTS. R. L. Murray (Alco Products, Inc., Schenectady, N. Y. Nuclear Power Engineering Dept.). June 20, 1962. Contract AT(30-1)-2639. 14p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The theoretical basis for computing an energy-group-averaged diffusion coefficient is examined. The matter of choice of an average of the diffusion coefficient or the transport cross section is given special attention. (auth)

31187 (CRT-1218) SPHARCYL—A COMPUTER PROGRAM FOR USE IN APPLICATIONS OF THE SPHERICAL HARMONICS METHOD. H. H. Clayton (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Apr. 1965. 15p. (AECL-2246). Dep.; $0.50(AECL).

An APEX procedure for use in applications of the spherical harmonics method to the approximate solution of one-group neutron transport problems in a multi-layer region having complete cylindrical symmetry is described. (auth)

31188 (EANDC(E)-58(U)) COMPILATION OF REQUESTS FOR NEUTRON DATA FROM EURATOM COUNTRIES. (European-American Nuclear Data Committee). Mar. 1965. 41p. Dep.(mn).

A compilation is presented of some of the requests for neutron cross sections and related data which were screened by the Euratom Nuclear Data Committee. The requests were classified in three priority categories. (D.L.C.)

31189 (GA-6026) HEXSCAT—COHERENT ELASTIC SCATTERING OF NEUTRONS BY HEXAGONAL LATTICES. Y. D. Naliboff and J. U. Koppel (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Dec. 15, 1964. Contract AT(04-3)-167. 20p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The HEXSCAT code calculates the P_0 and P_1 components of polycrystalline coherent elastic neutron scattering cross section per nucleus for a hexagonal lattice, according to a general expression which is presented. Expressions for the crystal form factor are developed, and simplified for the cases of graphite and Be. HEXSCAT, in FORTRAN IV for IBM 7044, evaluates the general expression and averages the cross sections over energy groups. The card input is described. Calculated coherent elastic cross sections of Be, at 0.005 to 0.2 ev, are compared with previous calculated and measured values. (M.J.T.)

31190 (GEAP-4782) TRANSPORT EQUIVALENT DIFFUSION THEORY. Quarterly Progress Report No. 3, October 1–December 31, 1964. G. H. Kear (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 11, 1965. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 18p. (EURAEC-1315). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The spatial averaging of the diffusion coefficient derived from boundary conditions imposed by transport theory is discussed. These multi-group values may be obtained for non-multiplying media in a straightforward manner. For multiplying media, however, the problem is more complex and is not amenable to the usual approximation methods. (auth)

31191 (INR-564/IX-A) PULSE METHODS IN REACTOR PHYSICS. R. Bednarz, J. Mika, Z. Ogrzewalski, and T. Rzeszot (Institute of Nuclear Research, Warsaw (Poland)). Nov. 1964. 25p. Dep.

A survey is given of the current status of research in the field of pulsed-neutron experiment and theory, prepared for the discussion at the joint Committee Meeting of the Norway-Poland-Yugoslavia Project in Reactor Physics. Theories of pulsed neutron experiments are discussed, including the time-dependent Boltzmann equation, the diffusion approximation, and calculations in nonmultiplying and multiplying media. Experimental methods are reviewed, with discussions of neutron sources and measurements of time decay constants and spectra in moderators and of spectra in multiplying media. Status of pulsed-neutron research in Poland is reviewed. (M.J.T.)

31192 (KAPL-3080) CALCULATION OF THE NEUTRON AGE IN HYDROGENOUS MEDIA. P. A. Ombrellaro (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 1964. Contract W-31-109-eng-52. 30p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A method of calculating flux and slowing-down ages from multigroup theory based on the Fourier transform method in the P-1 approximation is described. This method has been used to calculate the flux age to indium resonance energy for Zircaloy-water mixtures. The computed Zircaloy-water mixture flux ages for various metal-to-water ratios are compared with corresponding experimental flux ages for Zircaloy-water mixtures. As a check of the adequacy of the multigroup calculations based on various derived multigroup cross sections, three sets of oxygen cross sections available in the MUFT library were used to calculate the Zircaloy-water mixture flux age at each given metal-to-water ratio. The results obtained by the multigroup method are in reasonably good agreement with the experimental results. (auth)

31193 (NAA-SR-Memo-10918) AGE OF FISSION NEUTRONS TO INDIUM RESONANCE ENERGY IN IRON-WATER MIXTURES. PART II. THEORY. H. Alter

(Atomics International, Canoga Park, Calif.). [Apr. 6, 1965]. Contract AT(11-1)-Gen-8. 78p. Dep.(mn); $3.00 (cy), 2(mn) CFSTI.

The Monte Carlo Code, TYCHE-III, has been used to calculate with a high degree of convergence the second, fourth, and sixth spatial moments of the slowing down density distribution at the indium resonance energy, for neutrons originating from a fission source at a point in infinitely extended iron–water moderator. The effects of both inelastic scattering and anisotropy of elastic scattering in oxygen and iron have been included. These calculations have been compared with the moments of experimentally measured distributions of neutron flux at the indium resonance energy, after applying a suitable correction to the computed slowing down moments. (auth)

31194 (NP-15046) THE LIPRECAN I CODE — A MONTE CARLO PROGRAM FOR TWO DIMENSIONAL NEUTRON PENETRATION AND ENERGY DEPOSITION IN LIQUID HYDROGEN. R. H. Karcher (Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.). Apr. 5, 1963. 53p. (SM-43594)

LIPRECAN I is a two-dimensional Monte Carlo code which computes the penetration and energy deposition of neutrons in liquid or gaseous hydrogen systems. The code, which is written in FORTRAN for the IBM 7090, offers three possible geometries, i.e. conical, cylindrical, and one-dimensional infinite slab geometry (this latter option to the extent that an infinite slab may be approximated by a cylinder of very large radius). LIPRECAN I is equipped with a 218-point hydrogen cross section library. An interpolation routine is used to determine cross sections for discrete particle energies. This report includes a discussion of the application of stochastic sampling to the present model, complete instructions for using the code, a description of the input and output, a sample case, and a FORTRAN listing of the code. (auth)

31195 (ORNL-P-1167) PULSED-NEUTRON MEASUREMENT OF THE DIFFUSION PARAMETERS IN ORDINARY ICE AS A FUNCTION OF TEMPERATURE. Ernest Gerard Silver (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 19p. (CONF-650504-4). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From IAEA Symposium on Pulsed Neutron Methods, Karlsruhe, Germany.

Studies of neutron diffusion in H_2O ice were undertaken to determine whether the neutron spectrum becomes asymptotic in relatively short times at low temperatures and what the temperature effects on the diffusion coefficient and the diffusion cooling coefficients are. The preparation of the ice cylinders is described. Neutrons were produced by a deuteron beam incident on a deuterium target and were detected by a ^{6}LiI(Eu) crystal scintillator. Dimensions and bucklings of the cylinders used are listed. Neutron time decay was measured for each cylinder at temperatures from −85 to −5°C. Decay data were analyzed using a nonlinear least-squares fit computer program. Decay constants measured for each buckling and temperature are shown. Diffusion parameters were calculated from the measured cylinder dimensions and decay periods by an iterative procedure. No noticeable trapping effect was found in ice, and the inverse absorption lifetime was found to be independent of temperature. Values of the diffusion and diffusion cooling coefficients are compared with those from previous experiments and calculations. (M.J.T.)

31196 (RPI-328-35(p.1-34)) TIME-DEPENDENT THERMAL NEUTRON SPECTRA IN D_2O. R. C. Kryter, G. P. Calame, R. R. Fullwood, and E. R. Gaerttner (Rensselaer Polytechnic Inst., Troy, N. Y.). (RPI-328-34; CONF-650504-5)

From IAEA Symposium on Pulsed Neutron Methods, Karlsruhe, Ger.

The thermalizing properties of D_2O were studied by measuring the differential flux in a D_2O 50-cm cube at 43.3°C following a fast neutron pulse. Neutron spectra are presented over the time range of 20 to 200 μsec, and the energy range is limited to 0.6 to 0.006 ev. The early-time thermalization spectra show spectral shifts from the asymptotic diffusion-cooled Maxwellian. Spectral calculations were made using numerical solutions of the time- and energy-dependent diffusion P-1 equations. The experimental results were compared with calculations based on a free gas scattering kernel and on a bound incoherent scattering kernel. The kernel was found to be superior to the free gas model; however, both kernels correctly predict that the thermalization should be complete at 200 μsec. (D.L.C.)

31197 (RPI-328-35(p.125-35)) INELASTIC SCATTERING — CHOPPER METHOD. G. J. Kirouac, W. E. Moore, K. W. Seemann, and M. L. Yeater (Rensselaer Polytechnic Inst., Troy, N. Y.).

Polyethylene inelastic scattering cross sections were calculated using a bound atom model in which the optical vibrational levels were replaced by delta function Einstein levels. The results are compared with experimental cross sections at incident neutron energies of 0.158, 0.232, 0.336, 0.488, and 0.650 ev. The agreement of the inelastic and elastic peaks is discussed. (D.L.C.)

31198 (TIM-799) SCARF — A NEUTRON SCATTERING CODE FOR SNAP-TYPE RADIATORS. W. Granter (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Aircraft Nuclear Engine Lab.). Jan. 23, 1964. Contract AT(30-1)-2789. 23p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The SCARF radiator scattering code was written primarily to determine a first order approximation to the fast neutron current at a target point due to neutrons that scatter off a radiator fin. The code assumes an isotropic neutron source for each volume element in the reactor core and side reflector. The system geometry and the mesh structure of the reactor, fin, and target are described. Input parameters are listed, and output form is discussed; results for a sample calculation are given. (M.J.T.)

31199 (TPI-104) NEUTRON FLUXES IN ANTIMONY–BERYLLIUM SYSTEMS. S. A. Kushneriuk, P. M. Attree, and J. M. Kennedy (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov. 1963, Reprinted Mar. 1965. 24p. (AECL-2229). Dep.; $1.00(AECL).

Radioactive ^{124}Sb (half-life 60.4 days) disintegrates by the emission of β particles of various energies; the daughter nucleus, ^{124}Te is subsequently reduced to its ground state by emission of γ rays. In particular, 0.48 of the ^{124}Sb disintegrations yield a 1.692 Mev γ ray which has a relatively large cross section (1.35 mb) for the production of 25 kev neutrons in ^{9}Be via the γ-n interaction. Results are reported of calculations of the "thermal" neutron fluxes which develop in two types of antimony–beryllium systems: a radioactive antimony pellet contained in a beryllium blanket which is embedded in light water and radioactive antimony "pencils" embedded in a large block of beryllium. These results are intended to provide a basis for assessing the feasibility of using antimony–beryllium as sources of high thermal neutron fluxes. The threshold energy for the γ-n interaction in beryllium is 1.666 Mev. In the decay of ^{124}Sb, γ rays with energies greater than the 1.692 Mev mentioned above are also emitted. However, their contribution to the neutron production in beryllium is small and in the calculations, this production via the 1.692 Mev γ ray neutron production was included by increasing the fraction of the disintegrations which yield a 25 kev neutron to 0.50. Neutron fluxes are calculated by means of two-group diffusion theory. (auth)

31200 (WAPD-TM-501) RAM-1, A FORTRAN PROGRAM TO TRANSFORM AND AVERAGE CROSS SECTIONS FROM THE ROD LIBRARY TAPE FOR USE IN MULTIGROUP NEUTRON TRANSPORT PROGRAMS. D. R. Harris, C. B. Noll, and A. V. Vota (Bettis Atomic Power Lab., Pittsburgh, Pa.). Apr. 1965. Contract AT(11-1)-Gen-14. 30p. Dep.; $2.00(cy), 1(mn) CFSTI.

RAM-1 is a Fortran program designed as an aid in evaluation of neutron cross section data and in the preparation of cross section decks for multigroup neutron transport programs. Cross section data are retrieved from the ROC library tape, transformed if required, and averaged within

arbitrary energy intervals as weighted by arbitrary neutron spectra. Transformed and/or averaged cross sections are edited or are used to prepare a cross section deck as punched card input for the MILC program which prepares a cross section tape for the MUFT, P1MG and P3MG neutron transport programs. (auth)

31201 (ZfK-RN-25) UNTERSUCHUNG STARK GEHARTETER THERMISCHER NEUTRONENSPEKTREN AUF ABWEICHUNGEN VON DER MAXWELL-FORM MIT HILFE VON DUNNEN NICHT-1/v-SONDEN. (Investigation of Very Hard Thermal Neutron Spectra in Deviations From the Maxwell Shape Using Thin Non-1/v Probes). Dietmar Albert (Deutsche Akademie der Wissenschaften zu Berlin (East Germany) and Zentralinstitut fur Kernphysik, Rossendorf bei Dresden (East Germany)). June 1964. 79p. Dep. (mn).

By activity measurements with thin Lu, Eu, and Au probes, very hard thermal neutron spectra were measured in deviations from the Maxwell form. For identification of such spectra, another characteristic quantity, in addition to the neutron temperature, is necessary. For the evaluation of the probe measurements, models for the thermal spectrum, which contain two free parameters, were used. The results indicate clearly that deviations from the Maxwell form are detectable by integral methods. It is shown that non-1/v probes can be used not only, for example, to determine the position distribution of the neutron temperature, but also to make quantitative expressions on the fine detail of very hard thermal neutron spectra. (tr-auth)

31202 APPROXIMATIONS IN THE NEUTRON TRANSPORT THEORY. M. Pavelescu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 15: 335-53(1964). (In Rumanian)

The application of the fundamental equations of the neutron transport theory to reactor design is examined in detail, reviewing the various methods used to solve them. They include the spherical harmonics approximation, the P_1 approximation, the Fermi age approximation, and the Goertzel-Selengut approximation. In its usual form, the latter is an extension of the diffusion equation, treating the portion of the source due to the slowing down in H in an exact manner while the rest of the source is treated by means of the continuous slowing down model. (TTT)

31203 THE SPECTRUM OF NEUTRONS FROM A Po + Be SOURCE AND THE 7.66 Mev LEVEL OF C^{12}. Z. Dzierzbinska, K. Maluszynska, and L. Natanson (Lodz Univ., Poland). Acta Physiol. Polon., 27: 517-19(Mar. 1965).

The neutron spectrum of a Po + Be source was measured by recording proton recoil tracks in a photographic emulsion. For the reaction channel leading to $^{12*}C$ (7.66 Mev) an attempt was made to draw some information concerning the neutron angular distribution from the difference between the cms and the apparent laboratory spectrum. The angular distribution appears to reach a maximum at an angle $\varphi \geq 34°$. (auth)

31204 NEUTRON PULSE GENERATOR. G. E. Murguliya and A. A. Plyutto. At. Energ. (USSR), 18: 336-42 (Apr. 1965). (In Russian)

Descriptions are given of the design and performance of a neutron generator with a spark ion source. Experiments showed that for D + D and D + T reactions the generator produced pulsating neutron fluxes with the mean yield of $\sim 7 \times 10^6$ and $\sim 10^9$ per pulse, respectively, at general pulse duration of ~100 to 200 μsec and ~110 kv in the accelerating gap. (tr-auth)

31205 SPECTRA OF FAST NEUTRONS IN HEAVY MEDIA AND WATER. D. L. Broder, A. S. Zhilkin, and A. A. Kutuzov. At. Energ. (USSR), 18: 404-8(Apr. 1965). (In Russian)

The behavior of fast neutron spectra near a heavy media-water boundary was investigated. A scintillation spectrometer with a stilbene crystal combined with a photomultiplier FEU-13, and a 100-channel amplitude analyzer was used for measuring neutrons moderated in iron and lead from 3.4- and 15-Mev sources. The measurements were carried out in 710 × 710 × 600 mm iron and lead prisms with layers of iron and lead distributed between the accelerator target and the container with water. It is shown that with an increased thickness of iron or lead the neutron spectra are softer, moreover with iron they are considerably softer than in lead. During neutron moderation from a 14.9-Mev source the neutron accumulation is at $E_n < 4$ Mev which is in good agreement with evaporation model of inelastic scattering at identical neutron energies. (R.V.J.)

31206 ASYMPTOTIC RESOLUTION OF KINETIC EQUATION AND DIFFUSION PROPERTIES. Ya. I. Granovskii, and A. A. Kostritsa. At. Energ. (USSR), 18: 419-22(Apr. 1965). (In Russian)

An analysis of diffusion properties in asymptotic resolution of kinetic equation in the general case of scattering and source anisotropy showed that the properties are unseparable properties of the Green function in kinetic equation. Due to the neutron transfer kinetic equation linearity the solution can be presented as: $N(r,t,n) = \int_c^{i\infty} e^{i(qr-\omega t)} S(q, \omega,n)G(q,\omega,n)dq\,d\omega$, where $S(q,\omega,n)$ is the Fourier transform of neutron source and $G(q,\omega,n)$ is the Green function. The neutron density at long distances is determined by the distribution of special points $G(q,\omega,n)$ in the vicinity of $q = 0$. In the case in which the pole is close to zero the asymptotic density and flux are subordinate to diffusion equations. The equations for the diffusion length and the Fickian diffusion law in neutron transport theory are analyzed. (R.V.J.)

31207 PILE NEUTRONS IN NUCLEAR PHYSICS. I. Lovas (Universitet, Copenhagen) and Z. Zamori. At. Energy Rev., 3: 61-140(1965).

The main fields of nuclear physics in which the pile neutrons play an important role are outlined. The problems and methods of slow neutron spectroscopy are discussed, including a short survey of resonance parameter properties. The general features of gamma spectra arising from neutron capture are given. A comparison was made of the most frequently applied experimental techniques of gamma spectroscopy in the neutron-gamma reaction studies. Different methods for level spin assignment are discussed. Finally some fundamental problems connected with the properties of nuclear interactions are reviewed. (167 references). (auth)

31208 NEUTRON DOSE CONVERSION FACTORS FOR PuBe AND PoBe SOURCES. T. D. Jones, D. R. Johnson, and J. H. Thorngate (Oak Ridge National Lab., Tenn.). Health Phys., 11: 519-22(June 1965). (ORNL-P-21)

A calculational program and an experimental program were conducted to determine the average first-collision tissue dose in Rad/neutron per cm^2 produced by PuBe and PoBe neutron sources. Calculated values were obtained using a number of published spectra that were weighted according to the first-collision tissue dose as a function of neutron energy. In addition, a direct measurement was made of the energy deposited by the neutrons in a polyethylene-lined, cyclopropane-filled proportional counter. Calculated values were $4.08 \pm 0.20 \times 10^{-9}$ Rad/n/cm^2 for PoBe and $3.90 \pm 0.06 \times 10^{-9}$ Rad/n/cm^2 for PuBe. The corresponding experimental values were $4.0 \pm 0.2 \times 10^{-9}$ Rad/n/cm^2 for PoBe and $3.9 \pm 0.2 \times 10^{-9}$ Rad/n/cm^2 for PuBe sources. (auth)

31209 PRODUCTION AND COUNTING OF NEUTRONS. PART I. PRODUCTION OF NEUTRONS IN THE 18600 NEUTRON GENERATOR TUBE. F. de la Barre. Ingrs. Techniciens, No. 180, 103-7(Oct. 1964). (In French)

A simple, compact, high-yield, portable neutron generator tube was developed. The ion source, pressure regulator, and target of the tube are described, and its characteristics are given. (J.S.R.)

31210 MULTIPLE COLLISION METHOD FOR NEUTRON TRANSPORT PROBLEMS. T. Asaoka, Y. Nakahara, and K. Saito (EURATOM, Ispra, Italy). J. Nucl. Energy, Pt. A and B, 18: 665-701(1964). (EUR-1023.e)

An analytical method for solving transport problems is described, which is based on the random-walk approach.

Neutron transport in a homogeneous slab is treated in the constant cross-section approximation. Several physically significant solutions which describe reflection and transmission through a subcritical slab are then obtained by using expansions in spherical Bessel functions. Numerical results are obtained from these expansions by truncating the series. Neutron transport problems in a homogeneous slab are then considered for the case in which the cross sections for the medium are based on a two-group model. (D.C.W.)

31211 A SYSTEMATIC APPROACH TO THE DUCT STREAMING PROBLEM AND SOME RESULTS TO UNSCATTERED FLUX CALCULATIONS. Akira Tsuruo (Japan Atomic Energy Research Inst., Tokyo), Mitsuo Shindo, and Masahiro Kawabata. J. Nucl. Sci. Technol. (Tokyo), 2: 121-6(Apr. 1965).

A systematic plan for calculating the flux distribution at the center and near the exit of a straight cylindrical duct is proposed. An infinite plane source on one side of the shield barrier is assumed to have either an isotropic or a $\cos^n\theta$ angular distribution. To obtain the flux distribution on the other side of the shield barrier, calculation is performed to obtain separately the flux coming from the disk source at the entrance of the duct and the flux coming from the annular source surrounding the entrance of the duct. Moreover, unscattered flux, singly scattered flux, multiply scattered flux are considered separately. These fluxes are compared with that for the case of infinite slab shield without duct. The ratio of the unscattered flux ϕ_{duct} at the center of the duct exit to the unscattered flux ϕ_{slab} at a point behind the slab, and that of the unscattered flux $\phi_{annular}$ from the annular source to the unscattered flux ϕ_{disk} from the disk source are obtained for plane isotropic and plane cosine angular sources. The above mentioned technique of separate calculation provides a new approach to duct streaming problems. (auth)

31212 THE ASSESSMENT OF QUALITY FACTOR FOR HIGH-ENERGY NEUTRONS. Mechislav Zielczynski (Joint Inst. for Nuclear Research, Dubna, USSR). Nukleonika, 10: 77-80(1965). (In Russian)

The quality factor of radiation may be estimated experimentally by using the recombination method. The tissue equivalent ionization chamber in a water phantom is placed in the beam of high energy neutrons. The relative number of ions recombining in the columns in gas is the measure of the depth quality factor. The quality factor for neutron energies up to 680 Mev was established to be 2.8 ± 0.8. It changes only slightly with depth. (auth)

Nuclear Properties and Reactions

Refer also to abstracts 30168, 30179, 30260, 30527, 30529, 30561, 30567, 30629, 30630, 31101, 31203, 31459, and 31462.

31213 (AD-608695) [BIBLIOGRAPHY ON PARTICLE PHYSICS]. Final Report. Gregory Breit (Yale Univ., New Haven, Conn.). 1961. 11p. $1.00(CFSTI).

References (132) on nuclear scattering, nuclear particles, linear accelerators, isotopes, x-ray spectrum, polarization, electron capture, nucleons, protons, excitation, and nuclear reactions are given to journals, reports, and handbooks published from 1954 through 1961. (P.C.H.)

31214 (AD-613472) SURVEY OF SOME SYSTEMATIC PROPERTIES OF THE NUCLEAR E1 TRANSITION PROBABILITY. Charles-Fs. Perdrisat (Illinois Univ., Urbana. Dept. of Physics). [1964]. Contract AF49(638)-1048. 130p. $4.00(CFSTI.

The single-particle estimate for the electromagnetic transition probabilities is summarized. A classification of the E1 transitions with measured rates is proposed, as a function of the kind of nucleus and levels involved. A detailed discussion is given of the experimental data and the relevant nuclear models for transitions in odd- and even-A spherical and deformed nuclei. Data concerned with E1 transitions between bound states in medium and heavy nuclei (A ≥ 36) are collected in tables. 116 references. (M.J.T.)

31215 (ANL-7010(p.1-19)) FISSION PROPERTIES AND CROSS SECTION DATA. (Argonne National Lab., Ill.).

Experimental and theoretical studies of neutron interactions with nuclei found in the structural and fuel components of reactor systems are being carried out. A major portion of the effort is devoted to processes which involve fast neutrons. Particular attention is given to the experimental studies of neutron scattering, neutron capture, and to the properties of neutron-induced fission. Effort is also devoted to the design, optimization, and increased efficiency of the requisite experimental systems. The theoretical interpretations deal principally with average neutron resonance properties and reaction mechanisms in medium and heavy nuclei. (J.R.D.)

31216 (AWRE-O-13/65) A REVIEW OF EVALUATION OF NEUTRON CROSS SECTIONS AVAILABLE, NOVEMBER 1964. K. Parker (Atomic Weapons Research Establishment, Aldermaston (England)). Mar. 1965. 38p. Dep.(mn); $1.10(BIS), 5s. 6d.(HMSO).

A survey of evaluation work by countries and laboratories is given followed by a tabular summary of the available evaluations for each chemical element and for certain isotopes and chemical compounds. 111 references. (auth)

31217 (IDO-17042(p.11-47)) NUCLEAR TECHNOLOGY. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.).

Analyses are reported of: the total neutron cross section of ^{182}Ta at 5 to 100 ev; the alpha spectrum of ^{235}U; the activation cross section of ^{242}Am from ^{241}Am at thermal and resonance neutron energies; the ^{231}Pa alpha and gamma spectra at 0 to 830 kev; the neutron beam intensities from the HT-1 beam hole in MTR; neutron inelastic scattering by Al, liquid Ar, and liquid Na; neutron resonance absorption and interferences in ^{232}Th–^{238}U mixtures; the ^{103}Rh resonance absorption integral; and decay schemes, energy levels, and gamma spectra of various nuclei. 36 references. (T.F.H.)

31218 (IS-1032) MEASUREMENTS OF SOME INTERNAL CONVERSION COEFFICIENTS USING SCINTILLATION COUNTER, COINCIDENCE TECHNIQUES. Ronald S. Dingus, W. L. Talbert, Jr., and E. N. Hatch (Ames Lab., Iowa State Univ. of Science and Tech.). Feb. 1965. Contract W-7405-eng-82. 131p. Dep.; $4.00(cy), 3(mn) CFSTI.

Internal conversion coefficients were measured by observing with a well-type NaI(Tl) crystal the photon spectra emitted during the de-excitation from the first excited state to the ground state of ^{154}Gd, ^{160}Dy, ^{170}Yb, ^{171}Yb, and ^{141}Pr following the respective beta decays of ^{154}Eu, ^{160}Tb, ^{170}Tm, ^{171}Tm, and ^{141}Ce. The results were obtained by analysis of either the singles spectra, or spectra obtained by coincidence-sum techniques, or both. For the coincidence work gating was done either with high energy gamma rays or with beta particles. The spectra from the Yb isotopes were analyzed on a computer using a least-squares curve-fitting program. The photon detection efficiencies, necessary for the measurements, were calculated with a computer by performing numerical integrations. The following K-shell internal conversion coefficients were measured directly for first excited state to ground state transitions: 0.632 ± 0.016, for ^{154}Gd; 1.48 ± 0.05, for ^{170}Yb; 6.9 ± 1.0, for ^{171}Yb; and 0.375 ± 0.009, for ^{141}Pr. The total internal conversion coefficients were measured for the first excited state to ground state transitions in ^{154}Gd and ^{160}Dy and found to be 1.20 ± 0.02 and 4.52 ± 0.11, which yield respective K-shell internal conversion coefficients of 0.637 ± 0.016 and 1.54 ± 0.06 when multiplied by K-to-total ratios. The results for these $2^+ \rightarrow 0^+$ transitions in ^{154}Gd and ^{160}Dy and for this 1- forbidden M1 transition in ^{141}Pr agree with theory. The ratio of the experimental result to the theoretical value is

1.09 ± 0.06 for this $2^+ \rightarrow 0^+$ transition in ^{170}Yb. The result for this M1 + E2 transition in ^{171}Yb implies a mixing ratio of E2/M1 = 0.45 ± 0.09, assuming the theoretical internal conversion coefficients are correct. (auth)

31219 (IS-1071) SOME LIFETIME MEASUREMENTS OF ISOMERIC STATES IN THE RARE EARTH REGION WITH MAGNETIC COINCIDENCE BETA-RAY SPECTROMETERS. Robert E. McAdams and Eastman N. Hatch (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1964. Contract W-7405-eng-82. 180p. Dep.; $5.00(cy), 3(mn) CFSTI.

The half lives of nine isomeric states in the rare earth region were measured using magnetic beta-ray spectrometers and an associated fast-slow coincidence system utilizing a time-to-pulse-height converter. The half lives of the 8.40-, 118-, and 139-kev levels in ^{169}Tm were determined to be (4.13 ± 0.12) nsec, (63 ± 7) psec, and (289 ± 24) psec, respectively. The half life of the 8.40-kev level was determined using both ^{169}Er and ^{169}Yb decay. Several different methods were used to measure the 8.40-kev level lifetime including applying various accelerating voltages to the radioactive sources. Comparisons are made with theory for the K = 1/2 rotational band in ^{169}Tm. The half life obtained for the 8.40-kev level in ^{169}Tm corresponds to an energy level width of $(1.10 \pm 0.03) \times 10^{-7}$ ev. If there were no broadening of the individual line profiles in the Moessbauer effect pattern, the width at half-maximum of the resolved Moessbauer lines would be $(2.20 \pm 0.06) \times 10^{-7}$ ev compared to the narrowest experimental Moessbauer gross line width of 5.04×10^{-7} ev. The half lives of the 87- and 105-kev levels in ^{155}Gd were found to be (6.27 ± 0.35) and (1.20 ± 0.04) nsec respectively. Comparisons were made with the theoretical predictions of Nilsson for these two levels. The theoretical-experimental comparison would assign a spin of 5/2 to the 105-kev level and a spin of 3/2 to the 87-kev level if the comparison could be taken at face value. The half lives of the 122-kev level in ^{152}Sm, 89-kev level in ^{156}Gd, 396-kev level in ^{175}Lu and 80-kev level in ^{144}Pr were also determined. The half lives of these four levels were found to be (1.36 ± 0.06) nsec, (2.22 ± 0.08) nsec, (3.31 ± 0.10) nsec, and (143 ± 11) psec, respectively. (auth)

31220 (JINR-P-2031) γ LUCHI Tm^{164}. UROVEN TIPA O^+ V Er^{164}. (Gamma Rays of Tm^{164}. O^+ Type Level in Er^{164}). A. S. Basina, T. Bedike, K. Ya. Gromov, B. S. Dzhelepov, V. A. Morozov, and A. F. Novgorodov (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 13p. Dep.(mn).

The relative gamma-ray intensities in ^{164}Tm decay were measured. The values of α_k for some transitions were determined by comparing the gamma-ray intensities with previously obtained K-conversion line intensities. It was established that the 2^+ gamma vibrational level in ^{164}Er and the 0+ beta vibrational level possess the energies 862 and 1248 kev respectively. (auth)

31221 (KAPL-3085) OPTIC—A PROGRAM FOR THE CALCULATION OF NUCLEAR CROSS SECTIONS AND LEGENDRE MOMENTS USING THE OPTICAL MODEL. D. T. Goldman, C. R. Lubitz, G. A. Shanholt, and E. L. Slaggie (Knolls Atomic Power Lab., Schenectady, N. Y.). May 1965. Contract W-31-109-eng-52. 46p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

OPTIC is a Fortran digital computer program for the calculation of Legendre moments of the shape-elastic angular distribution, the total cross section, and the shape-elastic angular distribution itself, according to the optical model. A multidimensional search is available for obtaining the best potential well parameters. Fluctuations in nuclear cross sections are accounted for by combining resonance phase shifts with those calculated with the optical model. (auth)

31222 (LA-3266) THE INTERPRETATION OF NUCLEAR EXCITATION FUNCTIONS AT HIGH ENERGY: ERICSON FLUCTUATIONS. William R. Gibbs (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Mar. 15, 1965. Contract W-7405-eng-36. 58p. Dep.; $3.00(cy), 2(mn) CFSTI.

The interpretation of the nuclear reaction excitation function by statistical methods has been reviewed and results regarding errors and corrections have been presented. Special emphasis is placed on the effects of finite sample size on the amount of direct-reaction cross section extracted. Also treated are the effects of counting statistics, generalized frequency distribution functions, and the effect of finite sample size on frequency distribution functions. (auth)

31223 (LA-3270) EVALUATED NEUTRON CROSS SECTIONS FOR TRITIUM. Leona Stewart (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Feb. 1965. Contract W-7405-eng-36. 57p. Dep.; $3.00(cy), 2(mn) CFSTI.

Neutron cross sections on T are tabulated from 0.025 ev to 20 Mev. Graphs and tables are presented of the total, elastic, nonelastic, (n,γ), (n,2n), and (n,3n) excitation functions; and angular distributions from neutron elastic scattering from T. (T.F.H.)

31224 (LAL-1133) ELECTRON EXCITATION AT 180° OF THE GIANT DIPOLE RESONANCE IN Si^{28}. T. Stovall, J. Goldemberg, D. B. Isabelle, and D. Vinciguerra (Laboratoire de l'Accelerateur Lineaire, Univ. de Paris, Orsay (France)). Apr. 1965. 8p. Dep.(mn).

The giant dipole resonance on closed subshell nuclei (^{12}C,^{16}O,^{28}Si) was measured using inelastic electron scattering at 180°. Results are reported for cross section measurements on ^{28}Si, performed at momentum transfer of 153 and 223 Mev/c and excitation energies between 13 and 27 Mev. Form factors for the integrated cross section are given and compared with calculations using the particle-hole model. (M.J.T.)

31225 (NIJS-R-429) KINEMATICS OF MULTIPARTICLE REACTIONS. C. Zupancic (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). June 1964. 22p. Dep.(mn).

Connections between velocity vectors in multiparticle reactions, caused by momentum and energy conservation, are explored. Primary concern is with applications to low-energy nuclear physics. Nonrelativistic kinematics is considered, treating the consequences of momentum and energy conservation and Galilean invariance; phase-space predictions for cross sections are derived. The relativistic version of the same material is then presented. (M.J.T.)

31226 (NP-15018) COMPILATION OF EXPERIMENTAL EXCITATION FUNCTIONS OF SOME FAST NEUTRON REACTIONS UP TO 20 Mev. P. Jessen, M. Bormann, F. Dreyer, and H. Neuert (Hamburg Univ. (West Germany). I. Institut fuer Experimentalphysik). Jan. 1965. 156p. Dep.(mn).

A compilation in graphic form is given of measured excitation functions for the fast neutron reactions (n,p), (n,α), (n,2n), (n,np), and (n,nα). The Q-value is also presented for each reaction. 79 references. (M.J.T.)

31227 (NP-15026) ON THE THEORY OF MUON CAPTURE IN NUCLEI (thesis). Henricus Petrus Christiaan Rood (Groningen Rijksuniversiteit (Netherlands)). 1964. 116p. Dep.(mn).

Topics in the theory of muon capture are studied with the hope of providing information on the coupling constants for this process. Various nuclear models and methods of calculation of total muon capture rates are compared. Calculations are made with a simple shell model. Numerical results are given for ^{16}O and ^{40}Ca and compared with experiment; attempts to reach agreement with coupling constants required in the universal Fermi interaction are discussed. Photon spectra and total rate for radiative muon capture by complex nuclei are studied; comparisons are made for several approximations, including a statistical model and harmonic oscillator wave functions. Radiative muon capture is found to depend strongly on the induced pseudoscalar interaction. Theoretical results are also

derived for the circular polarization of photons emitted in radiative muon capture and for the directional distribution of the photons after capture of polarized muons. Results are presented in the form of general formulas and are evaluated numerically for typical cases. Partial muon capture rates in ^{16}O to the lowest bound states of ^{16}N are calculated, considering the transition matrix elements and single-particle operators in the particle-hole model. (M.J.T.)

31228 (NYO-1807-10) DIRECT EVIDENCE FOR THE ODD-EVEN L ANOMALY IN INELASTIC SCATTERING. K. R. Greider (Yale Univ., New Haven, Conn.). [1964]. Contract AT(30-1)-1807. 20p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

The unusual behavior of large angle differential cross sections for inelastic spin-independent processes, which is predicted by a diffraction model previously described, is explored. The dependence of the anomalous oscillating structure in the theoretical differential cross sections on whether the angular momentum transfer is even or odd is investigated for $O^+ \rightarrow O^+$, $O^+ \rightarrow 2^+$ and $O^+ \rightarrow 1^-,3^-$ transitions and the results are compared with previous experimental angular distributions for inelastic alpha scattering on ^{20}Ne, ^{24}Mg and ^{12}C. (L.B.S.)

31229 (ORNL-P-1067) SADDLE-POINT ROTATIONAL STATES FROM RESONANCE FISSION OF ORIENTED NUCLEI. J. W. T. Dabbs, F. J. Walter and G. W. Parker (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 13p. (CONF-650301-8). Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

From Symposium on the Physics and Chemistry of Fission, Salzburg, Austria.

An extension is made of experiments on the measurement of fission fragment anisotropy from ^{235}U in a $UO_2Rb(NO_3)_3$ single crystal to selected neutron energies in the resonance range and to temperatures down to 0.45°K. The theoretical aspects of the problem are discussed, and the experimental apparatus and results are described. (L.B.S.)

31230 (ORNL-P-1082) CHANNEL ANALYSIS OF NEUTRON INDUCED FISSION OF EVEN-EVEN ISOTOPES NEAR THRESHOLD. R. W. Lamphere (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 2p. (CONF-650301-9). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Symposium on the Physics and Chemistry of Fission, Salzburg, Austria.

A channel analysis was made of neutron-induced fission of even-even nuclei of mass 230 to 240 over the energy range close to the fission threshold for each case. The experimental method and results are discussed for ^{230}Th, ^{232}Th, ^{234}U, ^{236}U, ^{238}U, and ^{240}Pu. The method of analysis is also discussed, and curves of the fission cross section and fragment angular isotropy are presented. (L.B.S.)

31231 (ORNL-P-1088) CORRELATED FRAGMENT ENERGY MEASUREMENTS AND MASS-VS.-ANGLE CORRELATIONS IN ^{226}Ra + p FISSION. H. W. Schmitt, J. W. T. Dabbs, and P. D. Miller (Oak Ridge National Lab., Tenn.). [1965]. Contract [W-7405-eng-26]. 15p. (CONF-650301-10). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Symposium on the Physics and Chemistry of Fission, Salzburg, Austria.

Detailed fragment energy correlation measurements were carried out for proton-induced fission fragments of ^{226}Ra emitted at a center-of-mass angle of 90° with respect to the incident proton beam, for beam energies E_p = 11.0, 12.0 and 13.5 Mev. Similar measurements were carried out in search for a mass-angle correlation for E_p = 13.5 Mev, at 30°, 40°, 60° and 90°. A schematic diagram of the experimental arrangement is shown. The mass distributions and fragment kinetic energy as a function of proton energy and mass, respectively, are analyzed on the basis of the two-mode hypothesis. The mass-angle effect was found to be not sufficiently large to indicate a difference in angular distributions for masses in the symmetric and asymmetric peaks for first chance fission. The five percent effect is interpreted on the basis of a small probability for second chance fission. (L.B.S.)

31232 (ORNL-TM-1117) A GENERAL HAUSER-FESHBACH NUCLEAR-SCATTERING COMPUTER PROGRAM. William R. Smith (Oak Ridge National Lab., Tenn.). May 1965. Contract W-7405-eng-26. 16p. Dep. (mn); $1.00(cy), 1(mn) CFSTI.

A CDC-1604 binary program (for which no FORTRAN is available) is described that computes the scattering angular distribution and integrated cross section for any two-particle nuclear reaction, subject only to the restrictions that the spin of one particle in each reaction channel be no greater than 1 and that the maximum number of partial waves necessary in any one channel be no greater than 16. The input required by the program is the charge, mass, spins, parity, and optical-model parameters for all the channels through which the compound nucleus can decay. The calculation makes use of the Hauser-Feshbach theory modified to include spin-orbit coupling. (auth)

31233 (RPI-328-35(p.112-16)) NEUTRON CAPTURE MEASUREMENTS ON THE ISOTOPES OF TUNGSTEN. J. E. Russell, R. W. Hockenbury, and R. C. Block (Oak Ridge National Lab., Tenn.).

Neutron resonance energies are tabulated for $E \geq 98$ ev for the following isotopes: ^{182}W, ^{183}W, ^{184}W, and ^{186}W. (D.L.C.)

31234 (RPI-328-35(p.120-4)) INELASTIC SCATTERING OF SLOW NEUTRONS BY ZIRCONIUM AND TITANIUM HYDRIDES. S. S. Pan and M. L. Yeater (Rensselaer Polytechnic Inst., Troy, N. Y.).

The cross section for TiH_2 was computed assuming a certain vibrational line shape and a weighted acoustic mode. The computed cross section curve is compared with experimental results. The additional assumptions required to improve the agreement are discussed. (D.L.C.)

31235 (RT/FIMA(64)-3) FIP—UN PROGRAMMA IBM-7094 PER IL CALCOLO DELLE CONCENTRAZIONI DEI PRODOTTI DI FISSIONE. (FIP—An IBM-7094 Program for the Calculation of Concentrations of Fission Products). G. Casadei, G. Cenacchi, A. De Matteis, and B. Faleschini (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov. 1964. 26p. Dep.(mn).

An IBM-7094 code, FIP, has been written to compute the time-dependent concentrations of fission products. The main feature of this code is the simple preparation of the input data. These are restricted to the information about the nuclides present in the reactor and their constants. By means of these data, the program builds up the system of the differential equations ruling the physical processes, compiles the relative instructions, and solves numerically the system. (auth)

31236 (SGAE-PH-10/1964) MESSUNG DER KINETISCHEN ENERGIE DER SPALTBRUCHSTUCKE VON DER U-235 SPALTUNG. (Measurement of the Kinetic Energy of Fission Fragments From U-235 Fission). M. Schneeberger and H. P. Axmann (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). Oct. 1964. 8p.

Phosphorus-diffused (np) silicon detectors were used in ionization study of the kinetic energy of fission fragments from ^{235}U fission. The energy distribution of the fission fragments was measured to determine the counting properties of the semiconductor detectors. For the measurement of the kinetic energy, a two-detector system with the uranium foils, two amplifier stages, and recording unit was used. A two-dimensional energy analysis was made of the kinetic energy in the form of a contour diagram. (J.S.R.)

31237 (SGAE-PH-13/1964) QUELLENDICKENEFFEKTE IN DER BETA-SPEKTROSKOPIE. (Source Thickness Effect in Beta Spectroscopy). I. Hofmann and H. Baier (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). 1964. 9p. Dep.

The β spectrum of ^{24}Na was investigated on an intermediate image spectrometer using sources of various thicknesses. The shape-factor diagram obtained, normalized to the same activity, is given. A non-surface equal, thickness-dependent distortion of the permitted spectrum was obtained. The distortion signifies that sources of greater thickness emit more electrons on the inlet screen of the spectrometer than thin sources. A comparison was made between the measured and calculated spectra for 3 mg/cm^2 NaCl. (J.S.R.)

31238 (SGAE-PH-15/1964) MÖSSBAUEREFFEKT DER 46.5 kev-LINIE VON W-183. (The Mössbauer Effect of the 46.5-kev Line of W-183). Manfred Drosg (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut) and Endre Ujlaki (Vienna Univ. (Austria)). 1964. 6p. Dep.(mn).

The Mössbauer effect of the 46.5-kev line of ^{183}W was measured with a Xe-filled proportional counter with a resolution of about 10%. W plates were used as absorber, and both absorber and source were cooled with liquid nitrogen and held at a temperature of 80°K. A resonance absorption fraction of 4.4% could be established. Because of the poor resolution of the NaI crystal, a corrected effect of about 26% was obtained. (J.S.R.)

31239 (TID-21804) A SEARCH FOR A 1.65 Mev BETA-TRANSITION IN THE DECAY OF $_{25}Mn^{56}_{31}$. E. B. Arnold and H. J. Fischbeck (Harrison M. Randall Lab. of Physics, Univ. of Michigan, Ann Arbor). [nd]. Contract [AT(11-1)-1112]. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A search for the 1.65-Mev beta transition to the ^{56}Fe 4^+ level at 2.085 Mev was made, taking the beta spectrum from a plastic scintillator in coincidence with signals above 1.1 Mev from gamma rays detected in a NaI detector, thus discriminating against the strong beta transition to the first excited state of ^{56}Fe, whose de-excitation gamma is below 1.1 Mev. Counter calibration and data collection are described. Data were computer analyzed and fitted with a function developed by the computer; goodness-of-fit tests are discussed. Results were negative. (M.J.T.)

31240 (TID-21815) HIGHER ORDER EFFECTS IN THE ALLOWED BETA DECAY OF Mn^{56}. H. J. Fischbeck and W. M. Greenberg (Harrison M. Randall Lab. of Physics, Univ. of Michigan, Ann Arbor). [1964]. Contract AT(11-1)-1112. 8p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Measurements were made of the β-γ asymmetry for the 2.86-Mev transition in ^{56}Mn at average β energies of 1.3 and 2.3 Mev within an energy range of 300 and 500 kev, respectively, using an automated scintillation spectrometer. Theoretical expressions for the directional correlation, the shape factor, and the interfering second forbidden matrix elements in terms of the shell-model dependent factor are obtained. The measured directional correlation coefficient is used to find the shell-model dependent factor and hence the energy dependence of the shape factor. (M.J.T.)

31241 (UCRL-12473(p.1-30)) NUCLEAR AND ATOMIC PHYSICS. (Lawrence Radiation Lab., Univ. of California, Livermore).

The studies reviewed include analyses of: field-theoretical properties of the f_0 meson; the (n,γ) reaction on ^{51}V and ^{42}Ca, and the energy levels of ^{52}V and ^{43}Ca produced by these reactions; K-shell x-ray excitation of Al by protons at 0 to 500 kev; asymmetry coefficients in β-γ decay of ^{20}F and ^{28}Al; energy levels of ^{31}S; and energy levels of ^{19}Ne produced in $^{19}F(p,n)$ reactions. (T.F.H.)

31242 (UNC-5112) EFFECT OF RESONANCE OVERLAP ON THE DOPPLER COEFFICIENT FOR LARGE FAST REACTORS. C. C. Graves (United Nuclear Corp., White Plains, N. Y. Development Div.). Dec. 1964. Contract AT(30-1)-2832. 46p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The influence of resonance overlap on the predicted Doppler effect in large dilute fast reactors was determined from detailed numerical integrations of cross sections for sets of resonances constructed by random sampling methods. Calculations were made for a homogeneous mixture of ^{239}Pu, ^{238}U, and a scattering material giving a potential scattering cross section for the mixture equivalent to 50 barns per atom for ^{238}U and 400 barns per atom for ^{239}Pu. The resonance set of over 900 resonances was for s-waves ($l = 0$) only, and included three sequences: ^{238}U, $J = 1/2$; ^{239}Pu, $J = 0$; and ^{239}Pu, $J = 1$. Effective cross sections were obtained at neutron energies of 0.25, 0.5, 1.0, 2.0, and 5.0 kev and Maxwellian temperatures of 500 and 1500°K. Cross sections for both ^{239}Pu and ^{238}U were treated in terms of sums of Doppler-broadened, Breit-Wigner single-level formulas with contributions from up to eight resonances on either side of a given resonance. The two types of resonance overlap considered were: sequence overlap, which refers to the overlap of nearby resonances from a given sequence (e.g., ^{239}Pu, $J = 1$); and accidental overlap, which refers to the overlap of resonances from different sequences. (auth)

31243 (USNRDL-TR-822) ENERGY LEVELS IN ^{57}Fe. J. M. Mathiesen and J. P. Hurley (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 24, 1965. 16p.

The energies and intensities of the gamma rays from ^{57}Fe were measured using a high resolution Ge(Li) detector. Nine gamma rays were detected at energies of 14, 123, 137, 340, 353, 367, 570, 693, and 707 kev. Relative intensities of these transitions were also determined from these measurements. An energy level scheme is proposed and discussed. (auth)

31244 (ZfK-RN-23) SOME NEUTRON CROSS SECTIONS MEASURED AT THE ROSSENDORF RESEARCH REACTOR. (Zentralinstitut für Kernphysik, Rossendorf bei Dresden (East Germany)). Sept. 1964. 9p. Dep.(mn).

A compilation is given of cross section values measured at the Rossendorf Research Reactor. Tables are presented of thermal-neutron activation cross sections and half lives of produced activities, thermal-neutron absorption cross sections, resonance activation integrals and half lives of produced activities, slow-neutron potential scattering cross sections, and fission spectrum cross sections of threshold reactions. Measurement method, reference, and agreement or disagreement with previous results are indicated for each reaction. (M.J.T.)

31245 (ZfK-RN-27) BESTIMMUNG SCHNELLER NEUTRONENSPEKTREN IN EISEN MITTELS SCHWELLWERTDETEKTOREN. (Determination of Fast Neutron Spectra in Iron by Means of Threshold Detectors). Karlheinz Faehrmann (Deutsche Akademie der Wissenschaften zu Berlin (East Germany) and Zentralinistitut fur Kernphysik, Rossendorf bei Dresden (East Germany)). June 1964. 81p. Dep.(mn).

The work is for the preparation of spectrum measurements in the fast charge lattice in the Rossendorf ringzone reactor. As rough calculations for the system shown, the knowledge of the neutron spectrum in the energy range <1 Mev is of special significance. Therefore measurements in iron were carried out where the "soft" part of the spectrum is strongly increased by inelastic attenuation of fast neutrons. The measurements are, moreover, of practical interest since iron plays an important role as shielding material in the reactor. Various inelastic scattering processes, in which isomeric nuclei with low lying levels (<350 kev) and half life times of 10 min < $t_{\frac{1}{2}}$ < 12 days were formed, were investigated for their suitability in neutron spectrometry. By means of the reactions $^{103}Rh(n,n')^{103m}Rh$, $^{115}In(n,n')^{115m}In$, and the conventional threshold reactions $^{32}S(n,p)^{32}P$, $^{27}Al(n,p)^{27}Mg$, and $^{27}Al(n,\alpha)^{24}Na$, the neutron spectra in an iron block (50 cm $\phi \times 45$ cm) were determined for incident fission neutrons. In order to avoid absolute measurements, the probes were calibrated in a thin enriched uranium converter. A perturbed fission spectrum was assumed as a spectrum model, in which the perturbation function was represented as a superposition of exponential functions. The spectra measured were compared with those from a multi-group diffusion calculation. The energy sensitivity

of the reactions chosen was compared with that of the fission reactions (^{237}Np, ^{234}U, ^{236}U, and ^{238}U). (tr-auth)

31246 (JPRS-29270(p.87-103)) THE INTERFERENCE EFFECT OF NUCLEUS UNDER SHORT-RANGE FORCES. Tsung-Yeh Chang, Yu-wen Yu, Hsi-ch'uan Chu, Ch'ing-jun Li, and Yu Min. Translated from K'o Hsueh T'ung Pao, No. 1, 1-7(Jan. 1965).

The characteristics of the eigenstates of a two-particle system with δ-force is discussed under the L-S coupling approximation, assuming constant radial integrals. Based on its interference effect, an approximate method for obtaining the solution is proposed, which is compared with the rigorous solution and is found to be very close. The interference structure of particle-hole system is studied introducing the structure of the even parity state of ^{16}O and the structure of the odd parity state of ^{17}O. The results are compared with experiment. It is concluded that under the action of short-range forces, there exists strong interference effect in particle systems or particle-hole systems, therefore, the interference structure is a very good approximation. (L.B.S.)

31247 LOW-ENERGY NUCLEON SCATTERING, CONSIDERED FROM THE VIEWPOINT OF THE CURRENT NUCLEAR STRUCTURE MODELS. PART II. A. Berinde (Univ. of Burcharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 15: 181-245(1964). (In Rumanian)

A survey on the status of the theory of low-energy nucleon scattering is presented, with consideration of the optical and shell models and of competition between the mechanisms of direct interaction and compound nucleus formation. 115 references. (D.C.W.)

31248 ANGULAR CORRELATION BETWEEN PROMPT NEUTRONS AND FISSION FRAGMENTS IN THE CASE OF THE ^{235}U FISSION. A. Diaconescu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 15: 253-8(1964). (In Rumanian)

An attempt was made to clarify the fission mechanism by studying the angular correlation between the prompt neutrons emitted during the process and the fission fragments formed, using the derivations obtained by Ramanna and Rama Rao (Proc. Geneva Conf. 1958, P/1633, India, Vol. 15) who carried out electronic measurements of the angle between the velocities of the neutrons and the fragments. In the experimental work, a fission chamber filled with Ar at a pressure of 2 atm was used for recording the fission fragments, while the neutrons were recorded by means of a Hornyak-type scintillator connected to the photocathode of a photomultiplier, applying the pulses to a coincidence counter. The pulse-height amplitude and width obtained by the chamber depend on the angle enclosed between the trajectories of the fragments and the electric field. A U_3O_8 layer containing 99.9% ^{235}U and deposited on an Al support served as the fissionable layer. Measurements made with the synchroscope revealed that the maximum of the distribution of the coincidences plotted as a function of the delay lies at 5 μsec. The number of coincidences per second and per fission, plotted as a function of the angle between the direction of the electric field in the chamber and the axis of the photomultiplier in the laboratory system for the 1.3 and 1.8 fragments revealed an anisotropy. This confirmed the secondary theory formulated by Hill and Wheeler (Phys. Rev. 89: 1102(1953)), according to which the prompt neutrons are emitted during the flight of the fission fragments. (TTT)

31249 INTERACTIONS OF 12.8 Gev PROTONS IN NUCLEAR EMULSIONS. II. IDENTIFICATION OF THE CASCADE PRODUCTS OF HEAVY NUCLEI. J. Catala, E. Villar, J. L. Gomez, A. Lleo, P. Tarrega, R. Llosa, D. Gil, and J. M. Perez (Instituto de Fisica Corpuscular, Facultad de Ciencias, Valencia, Spain). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 60: 195-200(Sept.-Oct. 1964). (In Spanish)

Using both ionization and curvature in magnetic field measurements, an attempt is made to identify the white and grey tracks, from 96 interactions produced by 13.8-Bev/c protons on the heavy nuclei of the emulsion ($N_h > 8$). For $\beta > 0.57$ 68% were identified. The percentage of particles present in the nuclear cascade is given. (auth)

31250 MAGNETIC ANALYSIS OF THE ^{51}V(d,p)^{52}V REACTION. I. EXCITED STATES OF ^{52}V. J. Catala, A. Garcia, and J. M. Bolta (Instituto de Fisica Corpuscular, Facultad de Ciencias, Valencia, Spain). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A. 60: 201-6(Sept.-Oct. 1964).

The energy spectra of protons emitted from a vanadium target bombarded by 10.1-Mev deuterons were measured at 12 angles of observation between 5 and 87°30′, using a high-resolution multichannel magnetic spectrograph. A total of 37 proton maxima was unambiguously ascribed to levels of ^{52}V, up to an excitation energy of 3.66 Mev. (auth)

31251 CALCULATIONS OF THE MEAN SQUARE OF NUCLEAR RECOIL MOMENTUM IN EVAPORATION. F. P. Denisov and V. P. Milovanov. At. Energ. (USSR), 18: 403-4(Apr. 1965). (In Russian)

Calculations of the mean square of nuclear recoil momentum in evaporation were made taking into account nuclear motion induced by evaporation of all previous particles in the nucleus. (R.V.J.)

31252 ANGULAR DISTRIBUTION OF FAST NEUTRONS SCATTERED BY MEDIUM AND HEAVY NUCLEI. A. G. Guseinov, M. N. Nikolaev, A. G. Dovbenko, V. E. Kolesov, and V. N. Morozov. At. Energ. (USSR), 18: 409-15(Apr. 1965). (In Russian)

Angular distribution of fast neutrons scattered by Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Br, Zr, Nb, Mo, Ag, Cd, Sb, I, Ba, W, Ir, Hg, Pb, Bi, Th, and U(natural) was studied with a 5 cm neutron beam emitted from the active zone of BR-5 reactor. A fission chamber with ^{232}Th layers (containing ~1.0g thorium) was placed at 41 cm from the scatterer. Disks 45 mm in diameter were set at 45° angle to the beam. The experimental curves differential cross sections showed 3 to 6 and 8 to 12% error for the forward and backward scattering, respectively. The table of integral scattering cross sections β/N and expansion coefficients for Legendre polynomials showed that the magnitude of error factors for corresponding harmonics at various angular distributions, measured at identical angular points, did not differ from each other. In order to determine the relation between various harmonics, calculations were made of the matrix of correlation coefficients for magnesium. The low dependence of the expansion error factors on the atomic weight indicates that the matrix of correlation coefficients for other elements will not differ either. (R.V.J.)

31253 NUCLEAR ENERGY. WHAT IT IS AND HOW IT ACTS. Andrew W. Kramer, ed. Atomics, 18: 28-32 (May-June 1965).

Consideration is given to the shell model. Nuclear potential wells, harmonic oscillator potential, and importance of spin-orbit coupling in the shell model are discussed, along with shell model predictions and experimental results. (P.C.H.)

31254 THE ELECTROSTATIC COLLECTING OF RADIUM A AND THE PROPERTY OF THE β EMISSION OF THE RADIUM E FORMED FROM THE COLLECTED RADIUM A. Emmanuel Dubois, Jean Roche, and Pierre Andanson (Faculte des Sciences, Puy-de-Dome, France). Compt. Rend., 260: 3367-9(Mar. 22, 1965). (In French)

The β emission of ^{210}Bi formed from ^{218}Po collected by electrostatic pick-up on a simple conducting body increased with the atomic number of the collecting atom and tended toward a limit, almost attained beginning with Z = 47. (tr-auth)

31255 FLUCTUATIONS IN THE K^{39}(p,α)A^{36} REACTION. R. G. Allas, L. Meyer-Schuetzmeister, and D. Von Ehrenstein (Argonne National Lab., Ill.). Compt. Rend. Congr. Intern. Phys. Nucl., Paris, 2(1964): 695-6(1964).

The $^{39}K(p,\alpha)^{36}Ar$ reaction was investigated at proton energies from 10.5 to 13.0 Mev at angles 25 to 160°, and alpha groups leading to excited levels in ^{36}Ar up to 7 Mev were analyzed with solid state detectors. Autocorrelation coefficients show peaking at small and large angles, which demonstrate that the number of effective independent channels decreases toward these angles. The effect is pronounced in the transition to the ground state spin. The probability distribution of the alpha groups leading to the lowest excitation levels shows a general broadening at forward and backward angles. (L.B.S.)

31256 NUCLEAR SHELL NUMBERS IN LIGHT ELEMENTS. R. H. N. Iyer and G. Z. Shah (Bhavan's Coll., Andheri, Bombay). Current Sci. (India), 34: 209-10(Apr. 5, 1965).

The radial distribution method of Gatha and Shah was used to determine a characteristic nuclear density distribution on the basis of an analysis of the data on the elastic scattering of 180-Mev protons from light nuclei up to aluminum. The validity of the density distribution was tested by calculating nuclear shell numbers, which were compared with empirical values. (D.C.W.)

31257 REACTIONS (p,p′) AND (p,d) INDUCED BY 55 Mev PROTONS. K. Katsuda. Genshikaku Kenkyu, 8: No. 2, 205-16(1963). (In Japanese)

The differential cross sections of the (p,p′) and (p,d) reactions produced by modulated beams were determined. The results of reaction of a proton with Ni and Bi nuclei showed an indirect reaction, (p,p′), at high energies, but formation of a continuous spectrum and the reactions (p,2p), (p,2n), etc. at low energies. The reaction products were highly concentrated at the forward angle, which indicates a small recombination reaction and a slowly increasing cross section with increasing mass of the target nucleus. A scintillator was used to measure the individual energy levels of ^{12}C, ^{27}Al, ^{40}Ca, and ^{58}Ni in the (p,p′) reaction. A magnetic analyzer was used to measure the spectrum of the $^{40}Ca(p,p')$ reaction and the angular distribution of the ^{40}Ca 3.7 and 4.4-Mev levels, and the ^{208}Pb 2.6- and 4.3-Mev levels. The results showed that the ^{40}Ca 3.7-Mev and ^{208}Pb 2.6-Mev energy levels are in a doubly filled shell and that the angular distributions of the two ^{208}Pb levels are very similar. Since the angular distribution of this reaction is very dependent on Δl, experiments on the (p,p′) reaction near 50 Mev were of interest. Scintillator measurements of the $^{12}C(p,d)^{11}C$, $^{27}Al(p,d)^{26}Al$, and $^{58}Ni(p,d)^{57}Ni$ reactions and calculations of O_l^2 showed that the theory of the p group in an intermediate relation to ^{12}C, the Nilsson model for Al, and the pair theory for Ni basically agree with experimental results. Information on the 3-Mev vacancy state was obtained by (p,d) reactions on ^{40}Ca and ^{208}Pb with doubly filled shells. The results of the $^{40}Ca(p,d)^{39}Ca$ reaction indicate that the ground state of ^{39}Ca has d $3/2$, and its 2.6-Mev level has a spin of $s_{1/2}$. The theory that the 5.2-Mev $j = 3/2$-peak has two states, $j = 3/2^-$ and $j = 1/2^-$, and the 6.3-Mev peak a state $j = 5/2^-$ was verified by analysis. Angular distribution measurements on the $^{208}Pb(p,d)^{207}Pb$ reaction showed that more products are in the f state and are strongly concentrated in the forward angle; products in the h and i states are strongly concentrated in the forward angle, where the limiting cross section is Δl. (IIC-M.G.)

31258 REACTION OF ^{12}C INDUCED BY 54.9 Mev PROTONS. Kh. Takeya. Genshikaku Kenkyu, 8: No. 2, 217-30(1963). (In Japanese)

The cluster structure of ^{12}C and the energy levels of ^{9}B, ^{10}B, ^{10}C, ^{11}C, and ^{12}C were studied by reactions and inelastic scattering of 54.9-Mev protons on ^{12}C. (D.C.W.)

31259 REACTION (p,p′). S. Yamashita. Genshikaku Kenkyu, 8: No. 2, 233-40(1963). (In Japanese)

The (d,α) and (p,α) reactions were studied using a fixed-field cyclotron. The reaction products and the angular distribution indicated that the intermediate process is related to alpha clusters. Recent experiments with ^{12}C showed the basic structure of its alpha clusters. (A helium target was bombarded with 55-Mev protons, and coincidence measurements were made on the protons and alpha particles. These showed, besides the angular distribution of the p-He elastic scattering, the $^{4}He(p,\alpha)^{3}He$ reaction.) The nuclei were converted to polyethylene and the protons and alpha particles of the reaction products measured by coincidence methods. The bombarding proton energy was 53 Mev. The protons were counted at angles of 60, 80, and 100°, and the alpha particles at an angle near that of elastic p-He scattering; this could also be done by angular correlation. A peak value was observed near the p-He elastic scattering angle. A plastic scintillator was used as the proton detector, and a solid-state detector was used as the alpha detector. In previous experiments, plates with a nuclear emulsion were used, which gave rather imprecise results. In the present experiments the results were better because two counters were used for simultaneous measurement of protons and alpha particles. However, the energy of the recorded alpha particles is arbitrary. Therefore, alpha particles emitted in decay of an excited state of the residual ^{12}C nuclei from the $^{12}C(p,p')^{12}C$ reaction may be regarded as background. In subsequent experiments, alpha particles of a definite energy will be recorded, and ^{28}Al and higher nuclei will be used as targets to decrease the recoil effect. (IIC-M.G.)

31260 PRODUCTION OF SHORT-LIFE NUCLEI BY X-BREMSSTRAHLUNG AND METHOD FOR MEASURING THEM. T. Kamishi. Genshiryoku Kogyo, 9: No. 10, 59-63(1963). (In Japanese)

The production of isomeric states of nuclei, particularly by bremsstrahlung scattering, is discussed; and some methods for measuring the half-lives of isomeric states are described. Some measurements of the half-lives of isomeric nuclei are summarized, including the results. (D.C.W.)

31261 OPTICS OF THE TOTAL REFLECTION OF NUCLEAR RESONANT RADIATION BY Fe^{57}. S. Bernstein, E. C. Campbell, and C. W. Nestor, Jr. (Oak Ridge National Lab., Tenn.). J. Phys. Chem. Solids, 26: 883-94 (May 1965). (ORNL-P-108)

Measurements of the intensity of a single line ^{57}Fe λ-ray source totally reflected from an ^{57}Fe metal mirror as a function of angle of incidence and frequency of the source were previously described and compared with values calculated from theory. Several theoretical and computational aspects of the total reflection of Mössbauer radiation are discussed. Curves of reflectivity vs. glancing angle for a set of frequencies are given, showing how the curve shapes vary as the frequency of the λ-rays passes through the resonance frequency. Complete diagrams of the variation of coherent scattering amplitude with frequency for ^{57}Fe are given, from which the reflectivity as a function of frequency in the resonance region may be obtained by graphical interpolation. The polarization and changes in phase produced on reflection as a function of frequency are discussed, and calculated curves are shown. Because of the importance of the nuclear scattering in the resonance region the polarization and changes of phase produced on reflection are appreciable. (auth)

31262 ELASTIC AND INELASTIC SCATTERING OF 28.5-Mev ALPHA-PARTICLES FROM O^{16}, Ne^{20}, Mg^{24}, AND Si^{28}. Jun Kokame (Kyoto Univ.), Kiyoji Fukunaga, Hitoshi Nakamura, and Nobuyuki Inoue. J. Phys. Soc. Japan, 20: 475-87(Apr. 1965).

The elastic and inelastic scattering of 28.5-Mev alpha particles was investigated. Blair's phase rule is fairly well satisfied in forward angles (<90°) with a few exceptions. Some anomalous diffractive patterns were obtained for 4^+ states in ^{16}O, ^{20}Ne and ^{24}Mg, which have some common features. A relatively large yield from a doublet at 6.88 Mev in ^{28}Si seems to contradict the current assignment of spin-parity of the doublet. The inelastic scattering from unnatural-parity states in these nuclei shows a diffractive pattern and the relation between the phase and the angular momentum transfer is similar to the Blair's phase rule in spite of the reverse parity, except in the case of ^{16}O for which the relation is almost reverse. The reaction mechanism is considered most probably to be a

successive multiple excitation and/or an exchange process. (auth)

31263 NATURE OF THE DIPOLE STATES OF OXYGEN-16. B. M. Spicer (Iowa State Univ., Ames). Nature, 206: 813-14(May 22, 1965).

In analyses of the spectrum of photoneutrons from ^{16}O on bombardment by 34-Mev bremsstrahlung, it is pointed out that a normalization of the photoneutron spectrum to a measured $^{16}O(\gamma,n)$ cross section had to be made, and that, in making this normalization, both groups effectively guaranteed the conclusion at which they ultimately arrived. The only correct method of normalization is one that appeals to the total number of photoneutron events occurring, taking account of the proportion of $(\gamma,2n)$ events, and the data to make this approach are not currently available. Other methods of resolving this particular question are given. It was concluded that even at 3-4 Mev excitation in ^{16}N (that is, even as low as 16-17 Mev excitation in ^{16}O), there is mixing of 1 particle-1 hole and 2 particle-2 hole, and possibly higher configurations in the wave functions of the actual physical states. (P.C.H.)

31264 ON THE MODIFICATION OF YUKAWA POTENTIAL AND THE LAW OF CONSERVATION OF A TENSOR FIELD IN RIEMANNIAN TIME-SPACE. Jong Kook Jaen. New Phys. (Korea), 3: No. 1, 2-7(1963). (In Korean)

The modification of Yukawa potential is found from a point of view which is different from not only that done initially by H. Yukawa in 1935 but also that in modern quantized field theory. It is assumed that the 4-dimensional time-space around a nucleon is Riemannian instead of being interpreted as the Pseudo-Euclidean time-space. The basis of this assumption is discussed in detail. Next, a field equation analogous to Einstein's gravitational field equation in the classical field theory of relativity is constructed, which determines the fundamental metric tensor $g_{\lambda\mu}$ of the 4-dimensional Riemannian time-space around a nucleon. Furthermore, it is assumed that the source tensor $\Theta^{\lambda\mu}$ causing the Yukawa potential field ψ is symmetric with respect to the indices λ and μ. The wave equation of the scalar meson field is obtained under these assumptions in the spherically symmetric and static case. (L.B.S.)

31265 ANGULAR DISTRIBUTION OF SHOWER TRACKS. Nyong D. Kwon and S. H. Kim. New Phys. (Korea), 3: No. 1, 26-9(1963). (In Korean)

The tracks produced by 28-Bev protons in Ilford G-5 nuclear emulsion were scanned and some angular measurements were performed for shower tracks. The distribution of angles between primary and shower tracks is given, and the mean median angle θ, 15° 23′ ± 0.06′ is calculated. The azimuthal angles of each shower tracks are also calculated from the median angle and the distribution shows azimuthal asymmetry which agrees with the previously performed results by Stern, D. P, and Castagnoli et al. Some discussions are given to the determination of median angle of jet caused by 28 Bev protons and the comparison with the formula for calculating the energy of primary particles of order of 10^3 Bev. The results show that the formula is also useful for the calculation of energy of the primary particles of order of 10 Bev by giving some corrections. (auth)

31266 ON THE APPROXIMATION OF THE SOLUTION TO THE WAVE EQUATION FOR THE MODIFICATION OF YUKAWA POTENTIAL AND ITS APPLICATION TO A NUCLEUS WITH A SIMPLE STRUCTURE. Jong K. Jaen. New Phys. (Korea), 3: No. 2, 1-7(1963). (In Korean)

The approximation method similar to the stationary method in the perturbation theory of quantum mechanics is used for finding the approximate solution to the wave equation for the modification of the Yukawa potential. Application is made to the structure of the ^2H nucleus; and equations for the classical motion of the nucleon relative to the other are presented, from which the possibility that a nuclear repulsion exists in a small zone around the nucleon is inferred. (L.B.S.)

31267 NEUTRON-CAPTURE GAMMA RAYS. Till von Egidy (Technische Hochschule, Munich). New Phys. (Korea), 3: No. 2, 55-9(1963). (In Korean)

Methods for measuring neutron capture gamma rays or neutron capture conversion elections are reviewed, and the properties and efficiencies of various types of spectrometers used for the energy measurements are briefly discussed. (L.B.S.)

31268 VELOCITY DRIVE FOR MÖSSBAUER EXPERIMENTS USING AN AMPLIFIER WITH NEGATIVE OUTPUT IMPEDANCE. L. Loevborg (Research Establishment, Riso, Denmark). Nucl. Instr. Methods, 34: 307-10(June 1965).

A velocity drive of the constant acceleration type is described. Two mechanically coupled loudspeakers are used for the production of motion and measurement of velocity respectively. In order to make the velocity response of the system independent of the mechanical parameters an amplifier having negative output impedance is used, which improves the stability of the system when overall negative feedback is introduced. (auth)

31269 CORRELATED NEUTRON-PROTON PAIRS FROM THE PHOTODISINTEGRATION OF OXYGEN. J. Garvey, B. H. Patrick, J. G. Rutherglen, and I. L. Smith (Glasgow Univ.). Nucl. Phys., 70: 241-63(1965).

An experiment is described which was performed to study the photodisintegration of oxygen in the region of the quasi-deuteron interaction, for γ rays of energy about 250 Mev. The angular distribution of protons of energy 88.8-142.5 Mev, produced in coincidence with neutrons of energy 77 ± 17 Mev (FWHM) at 90° in the laboratory, was measured. The protons were detected in a scintillation counter, spark chamber telescope. The neutrons were detected in a scintillation counter, the energy being determined by a time-of-flight discrimination. The ground state of the oxygen nucleus is described by a Slater determinant of shell model wave functions and the corresponding form factor F(P), defined as the probability of there being a nucleon pair of momentum P and zero separation in the nucleus, is used in the calculation of the theoretical angular distributions. The cross section for the photodisintegration of the oxygen nucleus is written as $L(NZ/A)\sigma_d$, where σ_d is the cross section for the photodisintegration of a free deuteron, and L is a constant. Comparison between theory and experiment leads to a r.m.s. nuclear radius of 4.45 fm and a L of 10.3 ± 2.6. These values are compared with previous measurements and an attempt is made to justify the disagreements. Possible weaknesses in the theory used here are indicated. (auth)

31270 ISOSPIN SELECTION RULES FOR INELASTIC ELECTRON SCATTERING IN THE SHELL MODEL. J. B. Seaborn and J. M. Eisenberg (Univ. of Virginia, Charlottesville). Nucl. Phys., 70: 264-72(1965).

The E1 and M1 isospin selection rules for inelastic electron scattering are studied in terms of the particle-hole model. Form factors calculated for the 1^- levels of ^{16}O demonstrate the operation of the E1 selection rule in the T = 0 levels at low momentum transfer k. Isospin impurities are introduced phenomenologically and are found to break down this selection rule, particularly for the T = 0 level calculated at 23.0 Mev. The M1 isospin selection rule is studied for the closed sub-shell nucleus ^{12}C. Here only the configuration $(1p_{\frac{3}{2}})^{-1}1p_{\frac{1}{2}}$ is considered. Form factor calculations show that for $k \lesssim 300$ Mev/c the $\Delta T = 0$ transition is suppressed by a factor of about 1/200 relative to the $\Delta T = 1$ transition. This is consistent with the absence of the $\Delta T = 0$ transition in ^{12}C electro-excitation cross section measurements, even at fairly high momentum transfer. Isospin mixing in ^{12}C does not appreciably alter this result. (auth)

31271 STUDIES OF THE 84.2 kev E2 TRANSITION IN Yb^{170}. W. L. Croft, B.-G. Pettersson, and J. H. Hamilton (Vanderbilt Univ., Nashville). Nucl. Phys., 70: 273-92 (1965).

The K conversion coefficient of the 84.2-kev, 2^+ to 0^+, E2 transition in ^{170}Yb from the decay of ^{170}Tm was mea-

sured by scintillation and coincidence techniques to be 1.66 ± 0.11 and 1.52 ± 0.07, respectively, while theory gives 1.34. The beta-gamma, beta-K conversion electron and beta-L conversion electron directional correlations were measured for beta rays with energies above 600 kev with magnetic momentum analysis of the conversion electrons. Possible distortion of the beta-gamma correlation from the beta-inner-bremsstrahlung coincidences was observed. The measured anisotropics, $A(\pi)/A(\frac{1}{2}\pi) - 1$, uncorrected for solid angles are -0.140 ± 0.007 and -0.097 ± 0.006 for the β-e_K and β-e_L correlations. From these and the β-γ correlations, b_2 particle parameters of 2.56 ± 0.4 (2.32 ± 0.3) and 1.77 ± 0.2 (1.62 ± 0.2) were obtained for the K and L conversion electrons, respectively. The values in parentheses are uncorrected for β-inner bremsstrahlung coincidences. The theoretical value of $b_2(K)$ is 1.92. The high b_2 and α_K may indicate possible structure effects in the conversion process. Unfortunately no theoretical calculations are available for $b_2(L)$ for comparison with experiment. (auth)

31272 STUDY OF THE (t,p) REACTION ON O^{16}, O^{17}, AND O^{18} USING 5.55 Mev TRITONS. Raymond Moreh (Univ. of Manchester, Eng.). Nucl. Phys., 70: 293-304(1965).

The (t,p) reaction on ^{16}O, ^{17}O, and ^{18}O was studied at a triton bombarding energy of 5.55 Mev, with special attention to the reaction $^{17}O(t,p)^{19}O$. The position of several energy levels in ^{19}O was established. Good agreement was obtained in some cases between the measured proton angular distributions and the predictions of the plane wave double stripping theory. In other cases the contribution of other reaction modes seems to be appreciable. The spin and parity of the ground and 3.153-Mev levels in ^{19}O obtained by the $^{17}O(t,p)$ reaction were determined unambiguously to be $\frac{5}{2}^+$ arising from the $d_{\frac{5}{2}}^3$ and $d_{\frac{5}{2}}s_{\frac{1}{2}}^2$ configurations respectively. The 0.093- and 2.775-Mev levels could be identified with the $\frac{3}{2}^+$ and $\frac{3}{2}^+$ levels respectively of the $d_{\frac{3}{2}}^3$ configuration. The results for the $^{16}O(t,p)^{18}O$ reaction agreed with those of Jaffe et al. who used tritons of 5.50 Mev. In the $^{18}O(t,p)^{20}O$ reaction the spin and parity assignments for the ground and first three excited levels of ^{20}O were in essential agreement with those of Middleton et al who bombarded with tritons of 10 Mev. (auth)

31273 EXCITATION OF COLLECTIVE LEVELS IN Cu^{63} BY 50 Mev ALPHA-SCATTERING. B. G. Harvey (Univ. of California, Berkeley), J. R. Meriwether, A. Bussiere, and D. J. Horen. Nucl. Phys., 70: 305-12(1965). (UCRL-11895)

The excited levels of ^{63}Cu were studied by inelastic alpha scattering. Three quadrupole vibration levels at 0.668, 0.961, and 1.327 Mev are observed and are found to have enhanced B(E2) ↓ values. These are discussed in light of a core excitation model. Of the five enhanced octupole states observed at 2.51, 3.32, 3.51, 3.74 and 3.84 Mev, four probably arise from the excitation of the 3^-, ^{62}Ni core state. The fifth level might possibly be due to the promotion of the $p_{\frac{3}{2}}$ proton to the $g_{\frac{9}{2}}$ state. (auth)

31274 POLARIZATION OF NEUTRONS FROM THE $^7Li(p,n)^7Be$ REACTION FOR 3 TO 4 Mev PROTONS. W. D. Andress, Jr., F. O. Purser, J. R. Sawers, Jr., and R. L. Walter (Duke Univ. Durham, N. C.). Nucl. Phys., 70: 313-20(1965).

Six values for the polarization of the neutrons emitted at 50° in the reaction $^7Li(p,n)^7Be$ were obtained for proton energies from 3 to 4 Mev to a statistical accuracy of about 0.02. The solenoid precession technique was employed to reduce mechanical asymmetries. Elastic scattering from gaseous helium enclosed at high pressure in a thin-walled cell was used as an analyzer. Pulse-height discrimination on the helium-recoil scintillations was employed to eliminate the effects of the neutrons which leave ^7Be in its first excited state. The polarization was found to increase gradually from about 0.31 at 3 Mev to 0.38 at 4 Mev. In general, the results were consistent with previously measured values. (auth)

31275 EVIDENCE FOR G PARITY NON-INVARIANCE FROM THE BETA-DECAYS OF B^{12} AND N^{12}. R. J. Blin-Stoyle and M. Rosina (Univ. of Sussex, Brighton, Eng.). Nucl. Phys., 70: 321-34(1965).

All possible second-forbidden, electromagnetic and other charge-dependent effects which could account for the difference in the ft values for the β decays of ^{12}B and ^{12}N are considered. It is concluded that it is highly unlikely that such effects fully account for the difference, and it is suggested that there is, therefore, some evidence for the β decay interaction being non-invariant under the transformation G. (auth)

31276 NEW LEVELS IN Eu^{155}. L. Funke, H. Graber, K. H. Kaun, H. Sodan, and L. Werner (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Nucl. Phys., 70: 335-46 (1965). (In German)

The beta and gamma ray spectra and the $\gamma\gamma$- and $\beta\gamma$-coincidence spectra in the decay of ^{155}Sm (22 min) were measured, and new gamma transitions with energies 30, 65, 70, 75, 135, 175, 205, 310, 630, 700, 770, 850, 1030, and 1200 kev were found. Beta transitions in coincidence with gamma rays between 450 and 650 kev, 900 and 1050 kev, and 1100 and 1300 kev were observed, the maximum energy being (850 ± 50), (550 ± 30) and (300 ± 20) kev. A proposal for the decay scheme is given containing in addition to the known levels with the characteristics 105 kev ($\frac{5}{2}^-$) and 245 kev ($\frac{5}{2}^+$) new levels at energies of 75, 175, 310, 765, 875, 1095, and 1275 kev. Three of these may be interpreted as one particle state of the 63rd proton with characteristics $\frac{1}{2}$, $\frac{1}{2}^+[411]$, $\frac{3}{2}$, $\frac{3}{2}^-[541]$ and $\frac{3}{2}$, $\frac{3}{2}^+[422]$, the remaining probably being rotational states. (auth)

31277 ON THE ELECTRON CAPTURE DECAY OF Hf^{175}. L. Funke, H. Graber, K. H. Kaun, H. Sodan, and L. Werner (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Nucl. Phys., 70: 347-52(1965). (In German)

By measurements of the KX-γ-coincidence spectra of ^{175}Hf the K electron capture probability of the transition to the 433-kev level in ^{175}Lu was found to be $P_K = 0.68 \pm 0.04$. From this one obtains a decay energy $Q_{433} = 157$ kev for the transition to this level. The log ft values of the electron capture transitions determined with the total decay energy Q = 590 kev are in good agreement with data of corresponding transitions in neighboring nuclei. In the $\gamma\gamma$-coincidence spectra the 319-kev γ transition was observed, the intensity relative to the 343-kev transition being $I_{319}/I_{343} = 2.0 \times 10^{-3}$. (auth)

31278 TWO DIMENSIONAL GAMMA-GAMMA COINCIDENCE MEASUREMENTS IN THE DECAY OF Gd^{159}. L. Funke, H. Graber, K. H. Kaun, H. Sodan, and L. Werner (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Nucl. Phys., 70: 353-9(1965). (In German)

The decay of the 18h ^{159}Gd was studied by measuring the gamma single crystal spectrum and the $\gamma\gamma$-coincidence spectra. In addition to the known transitions in ^{159}Tb new coincidence pairs with energies of (245 ± 5) − 560 kev, (245 ± 5) − 615 kev, and (280 ± 5) − 580 kev and a transition of (860 ± 10) kev were found. The existence of these transitions requires the introduction of a level at 860 kev. (auth)

31279 ON THE LEVEL SCHEME OF Sm^{151}. L. Funke, H. Graber, K. H. Kaun, H. Sodan, and L. Werner (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Nucl. Phys., 70: 360-8(1965). (In German)

The gamma single crystal spectrum and the two-dimensional $\gamma\gamma$-coincidence spectra resulting from the decay of ^{151}Pm(28 h) were studied. As a result of this investigation new coincidence pairs were found at energies 100−770, 100−845, 170−230, 170−660, 170−710, 170−780, 210−240, 240−280, 240−575, 280−545, 290−450, 340−420, and 340-480 kev. The level characteristics are discussed on the basis of the Nilsson model. (auth)

31280 RECALIBRATION OF NUCLEAR REACTION ENERGIES FOR TARGET MASS NUMBERS A ≦ 70. A. Rytz (Bureau International des Poids et Mesures, Sevres, France). Nucl. Phys., 70: 369-82(1965).

Nearly 400 reaction energies were recalculated, using

the most recent calibration data, in order to get a reliable basis for nucleidic mass adjustments. (auth)

31281 ELASTIC AND INELASTIC SCATTERING OF DEUTERONS ON Ne, Ar, AND Kr. R. Jahr and G. Mairle (Max-Planck-Institut fur Kernphysik, Heidelberg). Nucl. Phys., 70: 383-91(1965).

Using a counter telescope technique, angular distributions of the deuterons were measured between 25 and 155° at an energy of 11.6 Mev and in the case of Ar also of 10.6 Mev. The elastic scattering on Ar and Kr is studied in terms of the optical model. The angular distributions of the inelastically scattered deuterons from the following levels were measured: ^{20}Ne, 1.63, 4.25, 4.97, 5.65, 5.80 Mev (the latter two not resolved), ^{22}Ne, 1.27 Mev and ^{40}Ar; 1.45, 2.53, 2.91, 3.22, 3.56, 3.71 Mev (the latter two not resolved). In the case of Kr two peaks were observed, the first of which can be assigned to the first 2^+ levels of the main isotopes contained in the target. A systematic study of the angular distributions from the first excited 2^+ states of several light nuclei shows that Blair's phase rule holds if these states have rotational character. The data further suggest that the 3.71-Mev level of ^{40}Ar has spin and parity 3^-. (auth)

31282 LIFETIME OF THE FIRST EXCITED STATE IN Ir^{189}. J. Jastrzebski (Inst. for Nuclear Research, Warsaw), H. Abou-Leila, and N. N. Perrin. Nucl. Phys., 70: 392-400(1965).

The lifetime of the first excited state in ^{189}Ir was determined by the time-to-pulse-height conversion technique to be 12.5 ± 1.0 ns. The B(M1) and B(E2) values were compared with those for similar transitions in other Ir and Au isotopes. The experimental data are consistent with the supposition that the main part of the wave function of the first excited state of these nuclei has a collective character. (auth)

31283 A NEW ISOMER OF Lu^{177} WITH 160 μsec HALF-LIFE. C. Heiser and K. F. Alexander (Deutsche Akademie der Wissenschaften, Berlin and Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Nucl. Phys., 70: 415-20(1965). (In German)

By activation of lutetium in a pulsed thermal neutron beam two delayed coincident γ rays of 110 ± 3 and 460 ± 5 kev were found. An isomeric state with a half life of 160 ± 10 μsec was assigned to ^{177}Lu using recently published precise capture γ-ray measurements of Maier. From the intensity ratio of x and γ rays it is concluded that the 110-kev transition is an E2 transition. The isomeric level at 570-kev excitation energy can be identified with the Nilsson orbital $\frac{1}{2}^+$ [411] which decays by hindered E2 radiation to the base state of the $\frac{5}{2}^+$ [402] band followed by M1 radiation to the ground state. The construction of a $\frac{1}{2}^+$ [411] rotational band was attempted. The value of the thermal neutron activation cross section for the isomeric state in ^{177}Lu is: $\sigma_{Lu^{177}m_9} = 315 \pm 60$ b. (auth)

31284 STUDIES OF EXCITATION CROSS SECTIONS OF (n,n'γ) REACTIONS. Kazuaki Nishimura, Kotoyuki Okano, and Shiroh Kikuchi (Japan Atomic Energy Research Inst., Tokyo). Nucl. Phys., 70: 421-48(1965).

The cross sections of the (n,n'γ) reactions of Fe, Co, Ni, Cu, Zn, Mo, Ag, Cd, and Sn were measured in the energy range from 0.3 to 2.6 Mev, using a ring-geometry arrangement. The excitation curves obtained on the low-lying levels of these nuclides are presented. The excitation curves of Ni, Zn, Mo, Ag, and Sn are compared with the results of optical-model calculations based on the statistical model of Hauser and Feshbach. The transmission coefficients used in the calculations are those derived from the optical model potentials as proposed by Beyster, Emmerich, Bjorklund, and Fernbach, Perey and Buck and Sugie. The calculated cross sections are appreciably larger than the experimental values, except for the case of molybdenum. The calculated cross sections based on the Moldauer theory are also compared with the excitation curves of Ni, Zn, Mo and Sn. In most cases, the results of the calculations by the Moldauer theory are in better agreement with the experimental ones than those of the Hauser-Feshbach calculations. (auth)

31285 THE DECAY OF ^{77}Ge AND ^{77}Ge^m. J. B. van der Kooi and H. J. van den Bold (Rijksuniversiteit, Utrecht). Nucl. Phys., 70: 449-70(1965).

Gamma rays in the decay of ^{77}Ge and ^{77m}Ge were investigated with scintillation spectrometers using γ-γ coincidence, sum-coincidence, and γ-γ angular correlation techniques. About fifty γ transitions were identified. A decay scheme is proposed including the following ^{77}As levels: 215 ± 2($\frac{3}{2}^-$), 263 ± 2($\frac{5}{2}^-$), (325 ± 15), 473 ± 3($\frac{5}{2}^+$), 632 ± 2($\frac{5}{2}^+$), 755 ± 4, (925 ± 15), 1195 ± 3($\frac{5}{2}$), 1280 ± 8, 1457 ± 6, 1557 ± 4, 1700 ± 15, 2001 ± 6, 2109 ± 10, 2232 ± 9, 2347 ± 4, (2445 ± 15), and 2565 ± 25 kev. Six of these levels have not been reported before. The ^{77m}Ge half life is 59 ± 2 s. (auth)

31286 EXCHANGE EFFECTS IN THE $Li^6(He^3,p)Be^8$ REACTION. N. R. Fletcher, J. D. Marshall, and R. H. Davis (Florida State Univ., Tallahassee). Nucl. Phys., 70: 471-9(1965).

The ^{6}Li(^{3}He,p)^{8}Be reaction was studied in the bombarding energy range 5 to 17 Mev. No compound nucleus resonances are apparent in the excitation curves. The angular distributions of protons leaving ^{8}Be in the ground state show a gradual change from a dominant back angle maximum at 5 Mev to a dominant forward maximum at 17 Mev. They are described well by the plane wave Born approximation with exchange (PWBAE) and above 7 Mev the energy dependence of the ratio of cross sections at 0 and 180° can be explained by the kinematics of the two-mode stripping process. Single-mode DWBA calculations do not fit the data at angles beyond the forward maxima. (auth)

31287 ON THE ROLE OF THE MONOPOLE TERM IN THE COULOMB INTERACTION BETWEEN CHARGED PARTICLES AND ATOMS. G. Ciocchetti and A. Molinari (Universita, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cimento (10), 37: 1376-9(June 16, 1965).

The importance of the monopole term in the ionization probability of atomic electrons by fast charged particles is stressed. The particular case of α decay of ^{210}Po is considered. (auth)

31288 NUCLEAR SPECTROSCOPY FROM THE $^{12}C(d,\alpha)^{10}B$ REACTION. F. Pellegrini (Universita, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 37: 1380-9(June 16, 1965).

The possibility of studying nuclear structure by (d,α) reactions was investigated. The experimental results obtained in the ^{12}C(d,α)^{10}B reaction at a deuteron bombarding energy of 15 Mev, were analyzed and compared with the theory of the two nucleon pick-up process. It was found that the ground and the 2.15-Mev states of ^{10}B can be described as two particle-hole states $(p_{\frac{3}{2}})^{-2}$, in the limit of J-J coupling. There is experimental evidence that the $J^\pi = 1^+$, 0.72 Mev and the $J^\pi = 2^+$, 3.58 Mev states can be described as coming from the $(p_{\frac{3}{2}})(p_{\frac{1}{2}})$ configuration. Finally in ^{12}C ground state an admixture of about 20 percent of $(p_{\frac{3}{2}})^6(p_{\frac{1}{2}})^2$ configuration was established. (auth)

31289 THE HIGH-ENERGY LIMIT OF THE STATISTICAL MODEL. H. Satz (Deutsches Elektronen-Synchrotron (DESY), Hamburg). Nuovo Cimento (10), 37: 1407-21 (June 16, 1965).

The sum over all N-particle phase space integrals for $N \geq 3$ $\Omega_R(P) = \Sigma_{N=3}^{\infty}[(2mR^3)^N/N!] \int \cdots \int \Pi_{i=1}^{N}(d^3p_i/2p_{i0})$ $\delta^{(4)}(\Sigma_{i=1}^{N} p_i - P)$ with interaction factor R is evaluated for high energies $W = \sqrt{P^2} \gg m$, using the limit-theorem formalism of statistics. Applied to the calculation of the multiplicity our result is shown to yield asymptotically Fermi's thermodynamic limit. (auth)

31290 ELECTRON SCATTERING BY DEFORMED NUCLEI. A. S. Reiner (Weizmann Inst. of Science, Rehovoth, Israel) and L. J. Tassie. Nuovo Cimento (10), 37: 1524-30(June 16, 1965).

Cross sections for the scattering of electrons by a deformed nucleus are obtained using the Born approximation. The electron excitation of states in the rotational

bands on the ground state and on the first β-vibration state are considered. Calculations were made for ^{152}Sm, ^{166}Er, and ^{178}Hf. (auth)

31291 RADIOCHEMICAL STUDY ON PHOTONUCLEAR REACTIONS ABOVE THE MESONIC THRESHOLD. I. PHOTOREACTIONS PRODUCED ON ^{127}I BY 1-Gev BREMSSTRAHLUNG. F. Salvetti, H. G. de Carvalho, V. di Napoli, and F. Dobici (CNEN, Rome and Universita, Rome). Nuovo Cimento (10), 37: 1728-30(June 16, 1965).

A systematic radiochemical study of the nuclides formed when complex nuclei are irradiated by bremsstrahlung beams in the range of 300 to 1000 Mev is described. Relative yields and cross sections at 1 Bev are tabulated for the ^{127}I (γ,n), (γ,2n), (γ,3n), (γ,4n), (γ,pn), (γ,p3n), (γ,p5n), (γ,p8n), (γ,2pn), (γ,2p3n), (γ,2p5n), (γ,3p7n), (γ,3p13n), and (γ,3p14n) reactions. (C.E.S.)

31292 HIGH-ENERGY SCATTERING BY SINGULAR POTENTIALS. N. Dombey (Univ. of Sussex, Brighton, Eng.). Nuovo Cimento (10), 37: 1743-6(June 16, 1965).

It is shown that the high-energy limit of scattering by a repulsive singular potential of the form $V(r) = A^2/r^{2n}$, $n > 3/2$, is very similar to that of scattering off a partially reflecting sphere whose transparency increases slowly with energy. (C.E.S.)

31293 A NOTE ON THE ASYMPTOTIC BEHAVIOR IN ANGULAR MOMENTUM FOR POTENTIAL THEORY. M. Scadron (Univ. of California, Livermore) and J. Wright. Nuovo Cimento (10), 37: 1747-8(June 16, 1965). (UCRL-12440)

An attempt is made to determine the asymptotic behavior of the partial wave amplitude for the Yukawa potential as $\mathrm{Im}\, l \to \infty$. A proof for real scattering energies $s \geq 0$ is presented. An L^2 norm that remains finite as $\mathrm{Im}\, s \to 0$, $s \geq 0$, is found. (C.E.S.)

31294 VIBRATIONAL STATES IN ^{134}Ba FROM THE DECAY OF ^{134}La. R. A. Ricci (Istituto Nazionale di Fisica Nucleare, Naples), G. Comite, R. Speranza, G. Gerschel, M. Pautrat, J. Van Horenbeeck, and J. Teillac. Nuovo Cimento (10), 37: 1752-5(June 16, 1965).

The decay of ^{134}La in equilibrium with long-lived parent ^{134}Ce produced by (p,6n) reactions on ^{139}La was investigated. Results on the vibrational behavior of the low-energy levels of ^{134}Ba. The proposed decay scheme of ^{134}Ce is illustrated together with the complete set of levels in ^{134}Ba. (C.E.S.)

31295 NUCLEAR SPECTROSCOPY OF SOME NEUTRON-DEFICIENT EVEN BARIUM ISOTOPES. G. Gerschel, M. Pautrat, R. A. Ricci, J. Teillac, and J. Van Horenbeeck (Laboratoire de Physique Nucleaire, Orsay, France). Nuovo Cimento (10), 37: 1756-60(June 16, 1965).

The level structure of ^{130}Ba and ^{132}Ba was investigated by studying the decay of ^{130}Ce, ^{132}Ce, and ^{132}La. The results indicate that ^{130}Ba and ^{132}Ba, together with ^{134}Ba, should form a sort of transition nuclei between spherical and deformed regions. (C.E.S.)

31296 MEASUREMENT OF THE POLARIZATION OF PROTONS ELASTICALLY SCATTERED ON ^{16}O. L. Drigo, C. Manduchi, G. C. Nardelli, M. T. Russo-Manduchi, G. Tornielli, and G. Zannoni (Universita, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 37: 1766-8(June 16, 1965).

Measurements on the elastic scattering of protons polarized by ^{16}O are presented. The polarized beam was achieved by irradiating a carbon foil with 5.200-Mev protons and extracting the protons deflected through 48° in the lab system. Diagrams illustrating the polarization as a function of the scattering energ are presented, and values of the scattering asymmetry as a function of energy and angle are tabulated. (C.E.S.)

31297 ISOTOPIC SHIFT IN THE ERBIUM SPECTRUM. D. A. Volkov and A. F. Golovin. Opt. Spectry. (USSR) (English Transl.), 18: 105-7(Feb. 1965). Translated from Opt. i Spektroskopiya, 18: 185-9(Feb. 1965).

With the aid of enriched isotopes of erbium, the shift between the components of the even isotopes ^{162}Er, ^{164}Er, ^{166}Er, and ^{170}Er was measured for 29 spectral lines of the neutral atom. Using the observed relative shift and the known static deformation parameters of the nuclei of erbium isotopes, the deformation parameter $\beta = 0.301 \pm 0.045$ and the internal quadrupole moment $Q_0 = (7.35 \pm 1.1) \times 10^{-24}$ cm^2 were calculated for the nucleus of the rare isotope ^{162}Er. (auth)

31298 A THEORY OF DEUTERON-INDUCED LOW-ENERGY REACTIONS. V. V. Komarov (Australian National Univ., Canberra). Proc. Phys. Soc. (London), 85: 867-74(May 1965).

With the aid of the method of summing infinite series of non-relativistic graphs, accurate integral equations are obtained for the deuteron-nuclear elastic and inelastic amplitudes at low energies. The method based on field theory using the second quantization formalism, was applied previously by Komarov and Popova for the solution of the three- and four-nucleon problem. (auth)

31299 ELECTRON NUCLEAR DOUBLE RESONANCE OF DIVALENT THULIUM IN CALCIUM FLUORIDE. R. G. Bessent and W. Hayes (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 285: 430-44(May 4, 1965).

An investigation was made of the ground state of ^{169}Tm^{2+} in CaF_2 by the endor method. The positions of excited crystal field states were known from the work of Kiss (1962) and with this information it was possible to obtain a value of $\mu_n = (-)\ 0.234 \pm 0.003$ nm for the nuclear moment of ^{169}Tm, which may be compared with the atomic beam value of $\mu_n = -0.229 \pm 0.003$ nm (Ritter 1962). The hyperfine interactions of the Tm^{2+} ion with the four nearest fluorine shells were measured. Both the thulium and fluorine endor line widths were investigated at X band and at K band and the results are discussed. (auth)

31300 HIGH-SPIN ROTATIONAL STATES IN DEFORMED NUCLEI. Kammuri, Tetsuo (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 33: 456-68(Mar. 1965).

The deviation of nuclear rotational spectra from the simple rotational pattern of a symmetric top is explained in the framework of the cranking model with pair correlations which change with angular velocity. To determine changes in the energy gap with angular momentum, a variational method is used and the gap is treated as a free parameter, chosen to make the energy in the rotating frame a minimum. The results obtained by the present model agree quite well with the experimental data for rare-earth nuclei. The critical spin corresponding to the vanishing gap is found to be about 30 to 40 in this region. (auth)

31301 THE MODIFICATION OF THE RESIDUAL INTERACTION DUE TO THE EFFECTS OF CORE EXCITATION. Ichimura, Munetake; Yazaki, Koichi (Tokyo Univ. and Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 33: 469-79(Mar. 1965).

The modifications of the residual interaction between two nucleons due to the effects of their interactions with the core of the nucleus are calculated to the second order in this interaction, using the adiabatic approximation. The modifications range from several % to 60%, depending strongly on the choice of parameters and also their multipolarity, isotopic spin, and spin characters. The connection with the phenomenological P_2-force is briefly discussed. (auth)

31302 CHARGE EXCHANGE NUCLEAR REACTIONS INDUCED BY A PION. Kohmura, Toshitake (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 33: 480-8(Mar. 1965).

The experimental situation for six types of charge-exchange nuclear reactions induced by a pion at low energy is discussed. A double charge exchange process without any change of the mass, which can never be attained by a nuclear reaction of a single nucleon, is shown to be more abundantly realized by the reaction (π^+,π^-) than by (π^-,π^+). The cross section for the reaction (π^+,π^-) turns out to be of the order of several ten μb, and the selection rule for the reaction is discussed. (auth)

31303 HALF-LIVES OF ARGON-37, ARGON-39, AND ARGON-42. R. W. Stoenner, O. A. Schaeffer, and S. Katcoff (Brookhaven National Lab., Upton, N. Y.). Science, 148: 1325-7(June 4, 1965). (BNL-8927)

The half lives of three argon isotopes were carefully determined, with the following results: ^{37}Ar, 35.1 ± 0.1 days; ^{39}Ar, 269 ± 3 years; and ^{42}Ar, 32.9 ± 1.1 years. By combining the ^{42}Ar value with earlier data, a cross section of 0.5 ± 0.1 barn was calculated for the reaction, with thermal neutrons, ^{41}Ar(n,γ)^{42}Ar. (auth)

31304 SPECTRUM OF PHOTONEUTRONS FROM URANIUM TARGETS. E. A. Kramer-Ageev and V. S. Troshin. Vopr. Dozimetr. i Zashchity of Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 12-15(1964). (In Russian)

The spectrum of fast neutrons from U targets shielded by 5 cm of lead is considered. The integral spectrum of such photoneutrons is shown. The U nuclear temperature is assumed to be 1.5 Mev; measurements were carried out along the 30-Mev linear electron accelerator beam. The experimental points were in fair agreement with the theoretical calculations obtained using the equation $F(E_n) \sim E_n e(-E_n/\theta)$, established earlier by V. Emma for Bi targets. Here, $F(E_n)$ is the relative number of neutrons per unit of energy; E_n is the neutron energy, in Mev; and θ is the nuclear temperature in Mev. The neutron spectrum could be determined only by the method of effective cross section. Consequently, a table for effective threshold cross sections and the results of spectrum measurements for the P, NH_5PO_4, Al, and Mg detectors ((n,p) reaction) and the Al detector ((n,α) reaction). (CFSTI)

31305 ALPHA ACTIVITY OF NATURAL NEODYMIUM. A. Isola and M. Nurmia (Univ. of Helsinki). Z. Naturforsch., 20a: 541-2(Apr. 1965).

The alpha activity of natural neodymium and enriched ^{144}Nd and ^{145}Nd was studied with gridded ionization chambers. The alpha energy of ^{144}Nd was found to be (1.83 ± 0.02) Mev and its half life (2.1 ± 0.4) × 10^{15} years. The alpha half life of ^{145}Nd was found to be longer than 6 × 10^{16} years. (auth)

31306 ON THE STATISTICAL OPERATORS OF DECAYING SYSTEMS. Walter Franz (Universitat, Munster in Westfalen, Ger.). Z. Physik, 184: 181-90(1965). (In German)

The relation between observation, statistical operators, and predictions is discussed, and some basic errors of von Neumann are indicated. In the application to the decaying system, it is assumed that during a macroscopic time the system was not decayed. The predictions can be obtained from the properties of the S matrix. The Gamow theory of α decay is discussed and its difficulties (complex energy, space-increasing wave function) are eliminated by the application of statistical operators. (tr-auth)

31307 THE CONVERSION OF Hg^{199m}. F. Smend, W.-D. Schmidt-Ott, and A. Flammersfeld (Universitat, Gottingen, Ger.). Z. Physik, 185: 426-36(1965). (In German)

The isomer ^{199m}Hg was produced from natural HgO by fast n irradiation. The cascade decay was investigated with scintillation spectrometers by application of the summing technique. The following results were obtained: half life $T_{\frac{1}{2}}$ = (43 ± 0.5) min; energy of the isomeric transition $E_{\gamma 1}$ = (375 ± 3) kev; conversion coefficients α_{K375} = 3.05 ± 0.25; α_{total} = 5.45 ± 0.25; yielding the multipole order of the isomeric transition to be M4 + (25 ± 15)% E5; energy of the second transition $E_{\gamma 2}$ = (159 ± 2) kev; conversion coefficients α_{K159} = 0.30 ± 0.03; α_{total} = 0.9 ± 0.1, confirming the multipolarity E2 of this transition. (auth)

31308 MEASUREMENTS ON 19.8 Bev PROTONS AND THEIR INTERACTIONS IN EMULSIONS. W. Enge (Universitat, Kiel). Z. Physik, 185: 456-77(1965). (In German)

In Ilford K 5-emulsions 190 nuclear interactions produced by 19.8-Bev protons were analyzed systematically. The mean interaction length was found to be 34.7 ± 2.5 cm, the mean number of shower particles is n_s = 4.5 ± 0.2, the mean number of heavy particles N_h = 9.0 ± 0.6. The integral momentum spectrum between the emission angles of 31 and 55° in the center of mass system shows a steep descent beyond 0.3 Bev/c with an exponent of −1.5 ± 0.3, the mean momentum is p^* = 0.60 ± 0.05 Bev/c and the mean inelasticity was found to be K = 0.37 ± 0.06. Scattering measurements could be done successfully up to an energy of 20 Bev. The scattering constant was found to be $K(t) = 20.4t^{0.055}$ (t in μ). Moreover there was found in treating errors that only the nonoverlapping cells are statistically independent, i.e. the standard deviation must be calculated only with half of the number of second differences. (auth)

31309 GAMMA RAYS FROM THERMAL NEUTRON CAPTURE IN Hg-199. B. P. Maier, U. Gruber, H. R. Koch, and O. W. B. Schult (Technische Hochschule, Munich). Z. Physik, 185: 478-87(1965). (In German)

A total of 103 gamma transitions in Hg 200 were observed. 37 of them were fitted into a level scheme which comprises 17 states. The energy of the one-phonon vibrational state $I = 2^+$ was determined to be 367.970 ± 0.020 kev, that of the two-phonon vibrational triplet 947.34 ± 0.07, 1029.37 ± 0.05, and 1254.20 ± 0.10 kev. Further levels were found at energies of 1570.30 ± 0.10, 1571.7 ± 0.6, 1594.3 ± 0.4, 1631.5 ± 0.2, 1641.5 ± 0.3, 1718.5 ± 0.2, 1730.8 ± 0.2, 1775.7 ± 1.1, 1842.9 ± 0.8, 1882.9 ± 0.3, 2062.6 ± 0.5, and 2082.9 ± 1.0 kev. (auth)

31310 NEUTRON CAPTURE RADIATION SPECTROSCOPY. H. Motz and G. Baeckstroem. p.769-804 of "Alpha-, Beta- and Gamma-Ray Spectroscopy." Amsterdam, North-Holland Publishing Co., 1965. (LA-DC-5155)

The neutron capture process, experimental arrangements for thermal γ-ray spectra, internal conversion and pair production, coincidence techniques, properties of levels, and the decay scheme of the compound nucleus are reviewed. The use of solid state detectors in future reaction γ-ray spectroscopy is briefly discussed. 113 references. (L.B.S.)

31311 EXPERIMENTS ON TRANSITION RATES AND INTERNAL CONVERSION. CLASSIFICATION OF NUCLEAR TRANSITION RATES. M. Goldhaber and A. W. Sunyar. p.931-49 of "Alpha-, Beta-, and Gamma-Ray Spectroscopy." Amsterdam, North-Holland Publishing Co., 1965. (BNL-7659)

A survey on the classification of gamma transitions is presented, covering selection rules and experimental methods and results. Lifetimes, matrix elements, multipolarities, and transition probabilities are considered with emphasis on internal conversion measurements. 50 references. (D.C.W.)

31312 ALPHA-DECAY. J. O. Rasmussen. p.701-43 of "Alpha-, Beta- and Gamma-Ray Spectroscopy." Amsterdam, North-Holland Publishing Co., 1965. (UCRL-10669)

The theory of alpha decay is reviewed primarily including concepts and theoretical formulas useful in α-decay research. Conservation laws, decay energies, and α-emission spectra are discussed, and closed decay energy cycles are presented for the 4n, 4n + 1, 4n + 2, and 4n + 3 series. The treatment of α-decay data is summarized. Problems of rate theory are treated with emphasis on approximate methods: decay rates of spherical nuclei, decay rate theory including noncentral interactions, and decay rates of odd-mass and odd-odd nuclei. (L.B.S.)

31313 MASSY ATOMOV I ENERGII SVYAZI YADER. (Nuclidic Masses and Binding Energy of Nuclei). V. A. Kravtsov. Moscow, Atomizdat, 1965. 376p.

The measuring method, instrumentation and calculations of nuclear mass and binding energy are described. Numerical tables of the atomic mass and nuclear binding energy and complete tables of the initial data for mass and binding energy calculations are also included. After a brief review of the basic nuclear structure models, the second part of the book deals with systematics of nuclear mass and binding energy which enables one to expand the concept of nuclear structure. 448 references. (R.V.J.)

31314 TWO-NUCLEON CORRELATION FUNCTION AND FINAL-STATE INTERACTION. D. Yu (Stanford Univ., Calif.). 6p. (CONF-758-21)

From American Physical Society Meeting, New York, Jan. 1965.

The possibility of studying the pair correlation function by simultaneously ejecting two closely correlated nucleons from a nucleus in a knockout reaction was studied theoretically. The angular correlation of the two nucleons was investigated as a function of momentum. The effects of final-state interaction and nuclear distortion were considered. (D.C.W.)

31315 Λ-HYPERON BINDING ENERGY IN VERY HEAVY HYPERFRAGMENTS. D. J. Prowse and Alice Lou (Univ. of California, Los Angeles). 5p. (CONF-758-23)

From American Physical Society Meeting, New York, Jan. 1965.

The binding energy of the hyperon (Λ) in heavy nuclei was determined by studying heavy hyperfragments produced in K-2 and K-5 emulsions exposed to an 800-Mev/c meson(K^-) beam. The well-depth of the Λ-nuclei was estimated from the average binding energy by applying a shape-independent model. (D.C.W.)

31316 NUCLEAR REACTIONS FOR DETERMINING NEUTRON SPECTRUM AND DOSE. A WORLD LITERATURE SEARCH. R. C. Barrall and W. N. McElroy (Illinois Inst. of Tech., Chicago). Vienna, International Atomic Energy Agency, World Health Organization, 1965, Preprint No. SM-56/3, 43p. (CONF-650302-7)

From IAEA Symposium on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation, Vienna.

When personnel experience high level neutron exposures, such as occur in criticality incidents, it becomes mandatory to determine the dose to the personnel involved. Under such circumstances one may wish to simulate the exposure with appropriate dosimeters in place. The neutron dose may be calculated if the neutron spectrum is obtainable. Error analysis studies indicate that integral neutron flux results accurate to ±10−30% may be obtained from foil data if the integral error of the basic cross section data as a function of energy is of the order of ±10% and the determination of disintegration rates is accurate to ±10%. Recent interlaboratory calibrations indicate that activity measurements to an accuracy of ±10% are readily obtainable. The basic cross section data are reviewed. Calculated average cross sections and measured average cross sections are compared. Approximately 35 reactions have been selected. The criteria by which the reactions were selected are: (1) the availability of cross section data; (2) the absolute magnitude of the cross section; (3) the relative shape of the cross section as a function of energy; (4) the decay scheme of the product nucleus; (5) other reactions and resultant products which occur in other isotopes of the target elements; (6) the availability of the target isotope in the required purity; (7) effects of temperature on the target material; and (8) half life of the product nuclide. From the list of reactions, one may select those which best apply to a particular problem also considering, in addition to the above criteria, such factors as cost in both time and effort. An important result of the study is to indicate the availability of suitable reactions other than the fission reactions. The comparatively low cost and relative ease of measurement of (n,γ), (n,p), (n,n′), (n,α) and (n,2n) reactions which result in a single radioactive product have the added advantage of requiring fewer assumptions in interpretation. In particular, the dependence of fission product yield on incident neutron energy is avoided. An analysis is presented of the response of the reactions as a function of neutron energy in various spectra. (auth)

31317 ALPHA PARTICLE EMISSION IN FISSION. I. Halpern (Univ. of Washington, Seattle). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-60/69, 24p. (CONF-650301-32)

From Symposium on the Physics and Chemistry of Fission, Salzburg, Austria.

An attempt is made to explain some of the most notable features of alpha emission in terms of reasonable assumptions concerning the nature of scission. The mechanism of emission is discussed, and the implications of the suggested mechanism are compared with experimental observations. The dependence of the alpha emission rate on the fissioning species, the fragment mass and kinetic energy, and the bombarding energy is considered. (D.C.W.)

31318 ON THE ROLE OF THE TRANSITION STATE NUCLEUS IN FISSION. J. R. Huizenga, J. P. Unik, and B. D. Wilkins (Argonne National Lab., Ill.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-30/3, 18p. (CONF-650301-16)

From Symposium on the Physics and Chemistry of Fission, Salzburg, Austria.

The suitability of the $(\alpha,\alpha'f)$ reaction for investigating the saddle or transition states in an even-even nucleus is stressed. Preliminary results obtained for the $^{238}U(\alpha,\alpha'f)$ reaction are discussed in relation to theoretical predictions about the low-lying states of an even-even transition nucleus. (D.C.W.)

31319 THEORETICAL CALCULATION OF THE NUCLEAR-RECOIL SPECTRUM FOLLOWING THE BETA DECAY OF He^6. J. N. Huffaker (Univ. of Alabama, Tuscaloosa). 9p. (CONF-641114-5)

From American Physical Society, Southeastern Section, Chattanooga.

A calculation of the momentum spectrum of recoiling ^6Li ions in beta decay of ^6He is outlined in which Coulomb effects were taken into account. The results are compared with experimental observations. (D.C.W.)

31320 MASS MEASUREMENTS USING (He^3,n) REACTIONS. Richard G. Miller and R. W. Kavanagh (California Inst. of Tech., Pasadena). 12p. (CONF-758-22)

From American Physical Society Meeting, New York, Jan. 1965.

The Q-values for the reactions $^{58}Ni(He\text{-}3,n)^{60}Zn$, $^{54}Fe(He\text{-}3,n)^{56}Ni$, $^{46}Ti(He\text{-}3,n)^{48}Cr$, $^{32}S(He\text{-}3,n)^{34}Ar$, $^{28}Si(He\text{-}3,n)^{30}S$, and $^{24}Mg(He/3,n)^{26}Si$ were measured; and the energies of the excited states observed were obtained. The neutrons were detected by reactions in the silicon of a solid-state detector. The measurements were made to determine the masses of ^{34}Ar, ^{46}Cr, ^{26}Si, ^{30}S, and ^{60}Zn. The analysis of the data is outlined. (D.C.W.)

Plasma Physics and Thermonuclear Processes

31321 (AD-609273) INVESTIGATION OF MAGNETICALLY INDUCED IONIZATION. Fourth Semi-Annual Technical Summary Report, May 1, 1964–October 31, 1964. B. Zauderer (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Contract Nonr 3867(00). 50p. $2.00(CFSTI).

Experiments were performed in the shock tube-MHD generator under the following conditions: The test gas was xenon with temperatures between 3600 and 9500°K, electron densities between 10^9 to 10^{16} electrons/cc, electrical conductivities between 0.01 and 3000 mhos/m. The magnetic field strength was varied from 5000 to 30,000 gauss. Six electrode geometries were used. The major results obtained were: Below electron densities of 10^{12} electrons/cc, sheaths effects at the electrodes completely controlled the generator performance. Between 10^{12} and 10^{14} electrons/cc, the sheath resistance was greatly reduced if the applied Faraday field was greater than 1000 v/m. Above 10^{14} electrons/cc, the electrode current mechanism was found to be the same as in the cold cathode arc and the sheath resistance was negligible. The measured Hall voltage was appreciably lower than the theoretical value. However, it was determined that the sheath effect was more

detrimental to the achievement of magnetically induced ionization than the low Hall voltage. (auth)

31322 (AD-610631) A SPECTROSCOPIC METHOD OF MEASURING ELECTRON DENSITY IN A SHOCK WAVE INDUCED ARGON–HYDROGEN PLASMA. Harry A. Gieske (Harry Diamond Labs., Washington, D. C.). Aug. 5, 1964. 45p. (TR-1238). $1.25(CFSTI).

A technique for the time-resolved measurement of electron density in a shock-heated argon–hydrogen mixture utilizing the Stark broadening of the hydrogen beta line (4861 Å) is described. Descriptions of experimental apparatus, procedures, and preliminary results are given for measurements made at the stagnation point of a blunt body and in the region behind the incident shock for Mach numbers between 8.8 and 11.6. Preliminary results show that time-resolved electron density measurements can be made using this technique but that calibration technique must be improved. (auth)

31323 (AD-610846) MICROWAVE AND OPTICAL PLASMA DIAGNOSTICS. Final Report. Theodore J. Morin, Jr. and George R. Peacock (Northeastern Univ., Boston, Mass.). Nov. 30, 1964. Contract AF19(604)-8462. 41p. (AFCRL-64-903). $2.00(CFSTI).

The theory and some experiments involved in making electron density measurements are described. Microwave and optical interferometric techniques are described in detail. Electrostatic probe theory is summarized in AD-288643. The apparatus constructed to perform these measurements is also described in detail. Techniques are described for performing several electron density measurements simultaneously. The emphasis had been on microwave and optical methods, with single and double probes included only for substantiation. It is concluded that extremely passive type measurements, such as optical interferometric methods, in particular with the use of a laser as a light source will emerge as one of the most important plasma diagnostic techniques. (auth)

31324 (AFCRL-64-745) STUDY OF A PLASMA OF ARGON AND ARGON–HYDROGEN MIXTURE. Technical Note No. 2. A. Constantin, J. Godart, J. J. Hamm, and R. Rioux (Paris Univ., Orsay (France). Faculte des Sciences). [1963]. Contract AF61(052)-727. 26p. (AD-606649). $2.00(CFSTI).

The relative importances of elastic, inelastic, electron-ion and electron-electron collisions are investigated for plasmas of argon and argon–hydrogen mixture. A differential equation, which neglects propagation effects, is given, allowing the calculation of the conductivity of a plasma when the isotropic part of the distribution function is known. The computation of stationary conductivity of an argon plasma with small amounts of molecular hydrogen is made for a Maxwellian distribution function. (auth)

31325 (ARL-65-48) INVESTIGATION OF THE INTERACTION OF A PREIONIZED GAS WITH AN ELECTRIC ARC. H. N. Olsen, C. D. Maldonado, A. P. Carson, and L. R. Dawson (Northrop Space Labs., Hawthorne, Calif.). Dec. 23, 1964. Contract AF33(615)-1105. 56p.

The free-burning d-c electric arc and plasma jet operating in argon at atmospheric pressure were accurately calibrated and compared with independent measurements made in other laboratories. These plasmas which constitute the basic components of a Lorentz force plasma accelerator were interacted to provide a general concept of the distorted plasma geometry to be encountered in a future basic research program aimed at the investigation of interacting plasmas in an external magnetic field. Because of the lack of circular symmetry in the interacting system of plasmas, new analytical methods were developed for converting externally measured integrated spectral line intensities to emission coefficients, a required step in the process of determining plasma temperatures. Theoretical consideration was also given to the effect of nonequilibrium on measured spectral line emission coefficients and the possibility of experimentally detecting any existing difference between electron and heavy particle temperatures. The effect of this nonequilibrium on gas density and static enthalpy was also included. (auth)

31326 (IPP-1/33) DIE STRAHLUNG EINES ZYLINDERSYMMETRISCHEN PLASMAS MIT AXIALEM MAGNETFELD IM BEREICH DER PLASMAFREQUENZ. (Bremsstrahlung Radiation from a Cylindrically Symmetric Plasma with Axial Magnetic Field). H. Gratzl (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Feb. 1965. 99p. (IPP-6/32). Dep.(mn).

The macroscopic dispersion relation was employed to calculate in a quasistatic manner the angular and frequency dependence of the radiation from a plasma column having the geometry of a theta pinch. Local thermodynamical equilibrium and the use of geometric optics for the frequencies of interest were assumed to be valid. It is shown how the bremsstrahlung intensity is altered in different ways for the ordinary and extraordinary rays, when the magnetic field is not negligible in the dispersion relation. (auth)

31327 (IPP-1/34) DIE SPEKTRALE LEUCHTDICHTEVERTEILUNG ENTLANG DER ACHSE EINES THETA-PINCHES BEI UNGESTORTER SPULENGEOMETRIE. (The Axial Distribution of Spectral Luminance of a Theta Pinch in a Coil with Undisturbed Geometry). E. Glock and K. Huebner (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1965. 11p. Dep.(mn).

An image was formed of the environment of the axis of a theta pinch in nitrogen through the slot of the collector plate upon the slit of a spectrograph. Thus the driving field was kept smooth and not spoiled by holes or slits in the coil. The spectra were photographed with an image converter and the time of exposure related to the signals of magnetic loops on the pinch. They showed that the plasma keeps well within the coil during the first two compressions and that the intensity of the spectral lines decreases smoothly from the middle to the ends of the coil. (auth)

31328 (JAERI-1077) STUDY ON THE COAXIAL TYPE PLASMA GUN. (Japan Atomic Energy Research Inst., Tokyo). Dec. 1964. 35p. (In Japanese). Dep.(mn).

The coaxial type plasma gun is described. The experimental results for the plasma gun are given and discussions are made on the following: the performances of the fast acting gas valves, which are mechanically and electromagnetically driven, the diffusion of the neutral gas puff from the fast acting gas valves, the parameters of the plasma blob ejected from the gun, the current sheet in the gun, and the analysis of the acceleration of the plasma by an analog computer. The so-called "spoke" instability during plasma acceleration in the gun and the break-up mechanism at the gun muzzle are discussed theoretically. (auth)

31329 (LA-3294) FEASIBILITY STUDY OF A PULSED THERMONUCLEAR REACTOR. F. L. Ribe, T. A. Oliphant, Jr., and W. E. Quinn (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Apr. 23, 1965. Contract W-7405-eng-36. 55p. Dep.; $3.00(cy), 1(mn) CFSTI.

The minimal conditions of burning time, plasma temperature, and number density yielding net energy balance in a pulsed reactor are investigated. The analog of a θ pinch is considered in which a long cylinder of $\beta = 1$ plasma is contained by a magnetic field, furnished by a single turn coil. The basic energy losses are joule heating of the coil by the magnetic field, heating of the coil by neutrons as they pass through it to the neutron blanket, and bremsstrahlung. The basic energy source is kinetic energy of the neutrons from d-t fusion reactions. Fuel burnup and α-particle heating of the plasma are also considered. Heat is removed from the beryllium-copper coil by means of turbulent flow of supercritical H_2O in channels. A coil temperature of ~500°C is consistent with the requirements of supercriticality of the H_2O. The energy required for pumping the heat-transfer coolant is taken into account in the energy balance. Two basic electrical models of the pulsed reactor are taken. In the first, all of the magnetic field B

is furnished by the coil. In the second, the sustained-field θ pinch, a steady magnetic field is suddenly pulsed off by an opposite magnetic impulse of short duration. For B = 200 kG the minimum burning times τ_T in the two cases are about 15 and 1.5 msec, respectively. The $n\tau_T$ product in the first case is about 10 times that of the Lawson criterion. In the second case it is almost the same. (auth)

31330 (MPI-PAE/P1-3/65) ZWEIDIMENSIONALE SELBSTKONSISTENTE LOSUNGEN DER STATIONAREN WLASSOWGLEICHUNG FUR ZWEIKOMPONENTEN-PLASMEN. (Two-Dimensional Self-Consistent Solutions of the Stationary Vlasov Equation for Two-Component Plasmas). Johannes Schmid-Burgk (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Mar. 1965. 53p. Dep.(mn).

Some solutions for the system of Maxwell's and Vlasov's equations for a plasma composed of two particle species of opposite sign are given. The magnetic field lines lie in planes perpendicular to which plasma and outer currents are flowing. The solutions include z-pinches contained in magnetic fields that are generated by outer currents of one direction only, and plasma regions that are separated from each other by curved surface layers. (auth)

31331 (NBS-8797) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Twenty-first Progress Report, January 1, 1965–March 31, 1965. (National Bureau of Standards, Boulder, Colo.). 4p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Results of a theoretical study of thin superconducting film behavior in perpendicular magnetic fields are summarized. Research work on magnet refrigeration is discussed. It is noted that reports were prepared on the Joule-Thomson process for cryogenic refrigerators, and reports on the analysis of pulsed refrigeration systems, and on pressure drop in the Brayton cycle are almost complete. (J.R.D.)

31332 (ORNL-3789(p.334-40)) CHEMICAL SUPPORT FOR THE CONTROLLED THERMONUCLEAR PROGRAM. R. A. Strehlow and D. M. Richardson (Oak Ridge National Lab., Tenn.).

Surface diffusion was indicated to be the dominant mechanism by which vacuum systems become contaminated with diffusion pump oil. The origin of methane in high-vacuum systems was indicated to be the reaction of C atoms in the surface of Ti metal with ionically pumped H. The reaction of water vapor with Ti surfaces was found to produce H_2 and CO. Methane, ethane, and higher hydrocarbons were found to be present in gases produced during operation of the DCX-2 experiment, indicating the presence of a surface contamination. Consideration of fuel cycle chemistry in tritium-burning controlled-fusion devices must include recognition of possible intolerably large inventory levels. Steady-state inventory levels in the presence of tritium ion or atom fluxes will be flux dependent but will in any event require appropriate design considerations. Processing for tritium recovery and for isotope separation from protium and deuterium will probably be an essential part of a tritium-burning device. Basic chemical considerations and some experimental corroboration led to the conclusion that inventory control by processes appropriate to the various regions of a controlled-fusion reactor is chemically possible. Initial power cost estimates for these processes were made and appear to be not prohibitive. (auth)

31333 (TID-21824) HIGH-TEMPERATURE PLASMAS BY LASER HEATING. Quarterly Progress Report No. 2, January 5, 1965–April 5, 1965. A. V. Phelps (Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.). Contract AT(30-1)-3472. 4p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Efforts directed toward production of plasma by irradiation of targets using pulsed lasers are discussed. Light emitted from vaporization of Al targets mounted on cross hairs was measured and the effects of plasma probes at various distances from the targets were studied. The target facility was dismantled during the period for installation of magnets and permanent vacuum pumps. Tests of the magnet and vacuum systems were started. (J.R.D.)

31334 (TID-21872) RESEARCH ON INSTABILITIES IN HIGHLY IONIZED LOW-PRESSURE METAL-VAPOR PLASMAS. Progress Report, January 1–March 31, 1965. M. F. Hoyaux, G. W. Penney, F. J. Young, V. M. M. Glaude, G. D. Linton, A. Kettani, and E. M. Williams (Carnegie Inst. of Tech., Pittsburgh, Pa.). Contract AT(30-1)-3100. 11p. (EAC-5) Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A theory for a cylindrical plasma-sac model is attempted, in which the plasma is considered as Maxwellian entering the sac. The basis of the study is therefore the Boltzmann equations for the electrons. The magnetic field is disregarded, and the phenomena are mainly electrostatic. (auth)

31335 (UCRL-12303) CONTROLLED THERMONUCLEAR RESEARCH SEMIANNUAL REPORT, JULY THROUGH DECEMBER 1964. (Lawrence Radiation Lab., Univ. of California, Berkeley and Lawrence Radiation Lab., Univ. of California, Livermore). Contract W-7405-eng-48. 163p. Dep.; $5.00(cy), 3(mn) CFSTI.

Operation of the Astron resulting in demonstration of trapping and confinement of single pulses of electrons is discussed. Operation of the 2x multiple mirror machine is also discussed along with modification of the Alice machine. Hot electron (~20 kev) plasma produced by adiabatic magnetic compression of cold plasma in the Table Top machine was investigated using quadrupole and hexapole windings. Work in the toroidal confinement program included Levitron measurements, alkali metal-vapor plasma experiments, stuffed-cusp experiments, theory of stable configurations, and theory of flute instability. Research is reported on rotating plasma, plasma decay, helium ion injection, and sheet pinch. Work on theoretical plasma physics is summarized along with engineering development. (J.R.D.)

31336 (UCRL-12473(p.72-9)) RADIATION PHYSICS. (Lawrence Radiation Lab., Univ. of California, Livermore).

Research is reported on laser-oscillator theory, nonlinear laser noise, and properties of plasma in thermodynamic equilibrium. (T.F.H.)

31337 (USCEC-82-218) INTERACTION OF MICROWAVES WITH AN INHOMOGENEOUS AND ANISOTROPIC PLASMA COLUMN. C. Yeh and W. V. T. Rusch (University of Southern California, Los Angeles. Engineering Center). May 1964. Contract AF19(604)-6195. 45p. (EE-38; AD-606976). $2.00(CFSTI).

The problem of the interaction of microwaves with a radially inhomogeneous plasma column confined by an impressed axial static magnetic field is treated analytically. Extensive numerical results from the backscattering cross sections are presented for various interesting ranges of the parameters involved. It is found that the often used homogeneous model for interpretation of experimental data can sometimes lead to ambiguous results. This ambiguity arises because of the interdependence of the average plasma frequency, the gyro-frequency, and the inhomogeneity of the plasma density distribution. Further measurements are suggested to distinguish these effects. (auth)

31338 DETERMINATION OF DIRECT CURRENT ARC PLASMA CURRENT DENSITY BY HALL-EFFECT MAGNETIC PROBE. Pin-Seng Tschang (Columbia Univ., New York). AIAA (Am. Inst. Aeron. Astronaut.) J., 3: 849-52 (May 1965).

A simple method of determining the current density of the cylindrical plasma column of an electric arc, based on the measurement of the self-magnetic field due to the arc drift current, is presented. This is accomplished by means of a miniature Hall-effect magnetic probe traversing the column diametrally at approximately 120 cm/sec. The theory of the Hall probe is briefly sketched, and the method of data reduction given. The probing unit was tested on the plasma column of the fluid-transpiration arc. Results of several representative probings are presented showing general conformity to theory of the arc self-magnetic field

radial profile. The results indicate that the fluid-transpiration arc current density is remarkably uniform over a large cross section of the column. The perturbative effects of the probe insertion on the plasma are analyzed. The advantages of using Hall probes as against coil-type magnetic probes are examined. (auth)

31339 AN ENERGY INVENTORY IN A COAXIAL PLASMA ACCELERATOR DRIVEN BY A PULSE LINE ENERGY SOURCE. A. V. Larson, T. J. Gooding, B. R. Hayworth, and D. E. T. F. Ashby (General Dynamics Astronautics, San Diego, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 3: 977-9(May 1965).

A pulsed coaxial plasma gun, powered by a pulse-line energy source, was studied. The partition of energy among the source, the magnetic field, and the work done on the plasma was determined from measurements of the magnetic field within the gun, together with the current and voltage at the terminals of the gun. The results show that a large fraction of the electrical energy stored in the pulse line is delivered to the plasma. (D.C.W.)

31340 COMMENTS ON "ELECTRON FLUCTUATIONS IN AN EQUILIBRIUM TURBULENT PLASMA." Frank Lane and Seymour L. Zeiberg (General Applied Science Labs., Inc., Westbury, N. Y.). AIAA (Am. Inst. Aeron. Astronaut.) J., 3: 989-90(May 1965).

The analysis by which Demetriades (AIAA J., 2: 1347-1349(1964)) obtained expressions for the proper average electron density and the rms fluctuation of electron density for a turbulent plasma in thermochemical equilibrium included an assumption that implied a particular probability distribution for the temperature. It is shown that this distribution consists of two delta functions, each of which is displaced from the average temperature by the rms temperature fluctuation. (D.C.W.)

31341 ON THE DEPENDENCE OF THE CHARGE DENSITY OF HYDROGEN LEVELS ON THE NUMBER OF BOUND STATES IN STATIONARY NONTHERMAL PLASMA. Hans-Werner Drawin (Euratom-CEA, Fontenay-aux-Roses, France). Ann. Physik, 14: 262-70(Nov. 1964). (In German)

For an optically thin hydrogen plasma, the system of equations for determining the charge density is solved for the statistical steady-state case, considering all collision processes from and to all levels. The solution gives the charge density in the ground state and in the excited states. The charge density is given as a function of the number of bound states. For high electron densities ($N_e > 10^{18}$ cm^{-3}) the charge density approaches a Boltzmann distribution and the ionization intensity of a Saha distribution. (tr-auth)

31342 QUANTUM STATISTICS OF REAL GASES AND PLASMAS. G. Kelbg and H. J. Hoffmann (Universitat, Rostock, Ger.). Ann. Physik, 14: 310-18(Nov. 1964). (In German)

The Slater sum of a quantum-mechanical many-body system was calculated for high temperatures. An $\hbar^2$-expansion of the density matrix was performed neglecting the symmetry effect. The expansion is given for various particles of different masses correct up to terms in $\hbar^6$. The correction term to the classical Boltzmann e-factor is fitted by coordinate-derivative of the potential energy H^1 of the system and contains linear and higher order terms. For the terms linear in the derivative of H^1, the entire $\hbar^2$-series was constructed and summed. For the case of a quantum plasma, the validity of data previously reported was verified. (tr-auth)

31343 CONSIDERATION OF SHORT-LIVED FORCES IN THE KINETICAL THEORY FOR MILDLY IONIZED PLASMAS AND ELECTROLYTES. H. Falkenhagen and D. Kremp (Universitat, Rostock, Ger.). Ann. Physik, 14: 322-4(Nov. 1964). (In German)

Approximating calculations were presented for the consideration of short-lived forces in the kinetic equations characterizing mildly ionized plasmas and electrolytes, and some corrections to the equations described by Fuoss, R. M., and Accascina, F., (Electrolytic Conductance, New York 1959), were presented. (auth)

31344 ELECTRICAL BOUNDARY LAYER CURRENTS GENERATED BY PLASMA FLOW. Leonard Aronowitz (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). Appl. Phys. Letters, 6: 215-16(June 1, 1965).

The generation of electric current due to ionized plasma flowing in a duct is discussed. An equation expressing the current is derived, and the results are shown to be closely related to previous experimental results. (M.O.W.)

31345 ELECTROMAGNETIC BACKSCATTER FROM OVERDENSE PLASMAS. Philip J. Wyatt (Defense Research Corp., Santa Barbara, Calif.). Appl. Phys. Letters, 10: 209-10(May 15, 1965).

The anomalous behavior of the backscatter from a large homogeneous plasma sphere in the region from four to twenty times the critical density is accounted for by an interference of the backscattered wave with surface waves induced by the incident field. (L.B.S.)

31346 INTERACTIONS OF MODULATED ELECTRON PULSE BEAMS WITH PLASMA IN A LONGITUDINAL MAGNETIC FIELD. A. K. Berezin, G. P. Berezina, L. I. Bolotin, Yu. M. Lyapkalo, and Ya. B. Fainberg. At. Energ. (USSR), 18: 315-22(Apr. 1965). (In Russian)

Studies of interactions between pulsed high-current electron beams and plasma in a longitudinal magnetic field showed that the interactions with modulated electron beams are much stronger than the interactions with non-modulated beams. Moreover, the preliminary modulated beams excite longitudinal waves with stronger (about 7 fold) electric field intensity than the non-modulated. (tr-auth)

31347 INTERACTIONS OF A STRAIGHT PLASMA CYLINDER WITH AN ALTERNATING QUADRUPOLE CONFIGURATION MAGNETIC FIELD. D. V. Orlinskii. At. Energ. (USSR), 18: 323-8(Apr. 1965). (In Russian)

Interactions of a straight cylindrical plasma with up to 4 kamp current with a high-frequency (~1.3 MH$_z$) quadrupole magnetic field (~100 Oe) were studied by simple diagnostic methods including discharge photography, magnetic field measurements, and recording of longitudinal magnetic flux. (R.V.J.)

31348 EXPERIMENTAL STUDIES OF PLASMA INJECTION IN PROGRAMMED MAGNETIC FIELD. O. I. Fedyanin. At. Energ. (USSR), 18: 329-35(Apr. 1965). (In Russian)

The studies of injected plasma capture by fast growing magnetic fields revealed the appearance of long-lived plasma cylinder localized away from the vacuum chamber walls with the plasma density ~10^{12}cm^{-3}. (tr-auth)

31349 THE EFFECT OF TEMPERATURE ON THE WIDTH OF A SMALL-AMPLITUDE, SOLITARY WAVE IN A COLLISION-FREE PLASMA. C. S. Gardner and G. K. Morikawa. Commun. Pure Appl. Math., 18: 35-49(Feb.-May 1965).

The effect of a finite plasma temperature on the solitary-wave solution in the study of hydromagnetic waves in a collisionless plasma is investigated. (D.C.W.)

31350 EXPONENTIAL DAMPING OF COLLISIONLESS PLASMA OSCILLATIONS. Harold Weitzner. Commun. Pure Appl. Math., 18: 307-11(Feb.-May 1965).

It is shown that for distribution functions which tend to zero as reciprocal powers of velocity for large velocity, exponentially damped plasma oscillations are obtained in the interval in which the oscillations are observable. (D.C.W.)

31351 MAGNETIC SURFACES AND PLASMA CONTAINMENT IN THE HELICAL FIELD OF A STELLARATOR WITH EXTERNAL INJECTION. G. M. Batanov, M. S. Berezhetskii, S. E. Grebenshchikov, N. M. Zverev, A. P. Popryadukhin, M. S. Rabinovich, I. S. Sbitnikova, and I. S. Shpigel. Dokl. Akad. Nauk SSSR, 160: 1293-5(Feb. 21, 1965). (In Russian)

Magnetic surfaces and external injection techniques in a 10,000-oersted longitudinal field stellarator (1200 mm large diameter and 100 mm small diameter) are discussed

briefly. The parameter ϵ, equal to the ratio of fundamental harmonic of field over longitudinal field, varies within the limits of 0.71–0.33, and the helical winding is at 45°. To verify the existence of magnetic surfaces, a pulsed electron gun is used as well as a 3×3 mm^2 probe. The results show an unperturbed magnetic surface at $\epsilon = 0.40$, a resonance excitation of the second kind at $\epsilon = 0.37$ with an external undisturbed surface, and an internal undisturbed surface with a resonance of the third kind at $\epsilon = 0.39$. The external injection was accomplished by means of four plasma spark injectors operating simultaneously for 0.4 μsec. Oscillograph studies indicate that the time for attaining a steady state distribution in density across the chamber corresponds to R/v_T, where R is the large chamber radius and v_T is the ionic thermal velocity. Comparing density distributions in the helical field to those of a toroidal field demonstrates the distinct influence of the former on the density distribution. (ATD)

31352 AMPLIFICATION IN A PLASMA AS A RESULT OF RECOMBINATION. L. I. Gudzenko and L. A. Shelepin (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR, 160: 1296-9(Feb. 21, 1965). (In Russian)

A qualitative analysis is made for processes occurring during the decay of highly ionized optically thin hydrogen plasma with an inverted population. The following three stages in plasma are considered: (1) strongly ionized plasma with instantaneously cooled free electrons, when the lower levels are practically unpopulated; (2) considerably ionized plasma, in which an equilibrium relaxation rate from overpopulated upper levels is established; and (3) weakly ionized plasma. On the basis of an equation for the rate of population change, a general relaxation scheme is discussed for plasma with an electron concentration between 10^{13} and 10^{16} cm^{-3} and free electron temperatures $kT_e \simeq 0.1 - 0.5$ ev. The relaxation time τ for the first stage was estimated to be $10^{-8} - 10^{-7}$ sec. The average number of electrons populating levels with the principal quantum number n = 2, 3, 4, 5, 6 during the second stage was calculated for $kT_e = 0.1$, 0.2, 0.3, and 0.4 ev and for free electron densities of 10^{12}, 10^{13}, 10^{14}, and 10^{15} cm^{-3}. The coefficients of absorption corresponding to transitions $n \rightarrow m$ (n = 2, m = 5) were calculated for the first and second stages, and it was shown that population inversion sufficient for laser action is maintained throughout the whole second stage ($\tau_2 \simeq 10^{-5}$ sec). It is pointed out that various effects not taken into account may become dominant during the third stage. These effects, such as the increased importance of metastable states, complicate the analysis of relaxation processes during the third stage. However, in contrast to the first two stages, it is relatively easy to maintain a stationary population inversion during the third stage. Because of the linear Stark effect, hydrogen is not considered to be the best medium for a plasma laser. The heating and cooling of free electrons in a gaseous discharge is also discussed. (ATD)

31353 ON AMPLIFICATION OF PLASMA WAVES BY A BEAM OF CHARGED PARTICLES ON THE INTERFACE OF TWO PLASMAS. S. M. Feinstein (Gor'kii State Univ., USSR). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 19-26(1965). (In Russian)

The problem of amplification and attenuation of plasma waves by a quasineutral beam of charged particles on the boundary between two plasmas is considered. (auth)

31354 PROPAGATION OF FINITE AMPLITUDE WAVES IN PLASMA TAKING INTO ACCOUNT THE EFFECT OF CHARGE SEPARATION. A. D. Pataraya. Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 27-33(1965). (In Russian)

The structure of finite amplitude waves propagating along a magnetic field in a collisionless plasma is investigated by the method of perturbation theory, taking into account the effect of charge separation. The corrections due to charge separation are obtained for the characteristic plasma parameters. (auth)

31355 TWO-DIMENSIONAL ELECTROMAGNETIC FIELDS GUIDED BY PLASMA LAYERS. PART II. I. G. Kondrat'ev and M. A. Miller (Gor'kii State Univ., USSR). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 34-41 (1965). (In Russian)

Some types of two-dimensional waveguide systems with gyrotropic plasma walls are considered. The reflection coefficient and the surface impedances are determined for plasma layers with a constant magnetic field oriented either along or across the direction of the wave propagation. The conditions are found in which such layers can shield the high-frequency electromagnetic fields. (auth)

31356 ENERGY LOSSES OF CHARGE MOVING IN NONHOMOGENEOUS MAGNETOACTIVE PLASMA. V. V. Tamoikin (Gor'kii State Univ., USSR). Izv.Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 42-9(1965). (In Russian)

Energy losses by the electromagnetic radiation are calculated for the motion of a charge in a magnetoactive plasma with random nonhomogeneities of the electron density. The charge is assumed to move along the magnetic field. It is shown that the radiation of both types of normal waves occurs in a nonhomogeneous magnetoactive plasma, in particular in the frequency range $\omega > \omega_p$ where Cherenkov excitation of the electromagnetic waves is impossible. Besides this, an effect of logarithmic increase of fluctuation-radiation intensity is noted when the radiation of extraordinary waves approaches the Cherenkov threshold. (auth)

31357 ON THE THEORY OF THE INSTABILITY OF ANISOTROPIC PLASMA WITH A BEAM. S. E. Rosinskii, A. A. Rukhadze, and V. G. Rukhlin (Lebedev Inst. of Physics, Moscow). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 50-6(1935). (In Russian)

The instability of an anisotropic plasma with a beam is investigated with respect to low-frequency oscillations, the collisions between particles being neglected. An infinite anisotropic plasma with a beam is shown to be unstable without external magnetic field, the directional velocities of the beam being arbitrarily small. The values of critical beam velocities are estimated at which a low-frequency instability appears in the bounded plasma. A strong magnetic field is shown to stabilize such an instability of the anisotropic plasma. (auth)

31358 ON THE PROPAGATION OF ELECTROMAGNETIC WAVES IN A MEDIUM WITH VARIABLE REFRACTION INDEX. L. P. Presnyakov and I. I. Sobel'man (Lebedev Inst. of Physics, Moscow). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 57-63(1965). (In Russian)

The approximate method of integration of the system of linear differential equations with variable coefficients developed in problems of atom excitation by heavy particles is applied to the computation of the reflection coefficient of a layer with an arbitrary real refraction index. (auth)

31359 ON RADIATION REACTION FOR THE LONGITUDINAL WAVE. G. B. Gorodinskii (Gor'kii State Univ., USSR). Izv. Vysshikh. Uchebn. Zavedenii, Radiofiz., 8: 64-9(1965). (In Russian)

A calculation is carried out of the radiation reaction in a medium with negative absorption in the presence of spatial dispersion. In such a medium a step-up of oscillator oscillations is shown to take place, which is $(c/V_T)^3$ times as intense as in a certain range of variation of V_T as that in a medium without spatial dispersion. (auth)

31360 DOMINANT AND NON-DOMINANT TERMS IN THE ENERGY TRANSFER EQUATIONS FOR A FULLY IONIZED PLASMA. N. E. Frankel (Univ. of Melbourne). J. Nucl. Energy, Pt. C., 7: 225-34(May-June 1965).

The energy transfer equations for a fully ionized plasma are obtained including, in the language of Chandrasekhar, the dominant and nondominant terms. The effect of the nondominant terms is investigated and shown in several cases to be significant. Comparison is made between these exact results and previous approximations which retain only the dominant terms. The regions of validity of these approximations are rigorously defined. Cases in which quantum effects occur are also treated. (auth)

31361 NON-ADIABATIC MOTION OF A PARTICLE IN A CUSPED MAGNETIC FIELD. W. Schuurman and H. de Kluiver (FOM-Instituut voor Plasma-Fysica, Rijnhuizen Jutphaas, Netherlands). J. Nucl. Energ, Pt. C, 7: 245-62 (May-June 1965).

Particle orbits in a counter Helmholtz field were investigated, both analytically and by means of a digital computer. The results give information about the containment time of a particle, the density distribution of particles within the Störmer regions, and particle reflection in the r- and z-mirrors. The containment time of 10 kev H^+-ions in a cusped field of 400 G/cm is 5 μsec, corresponding to an average density of 9×10^5 cm^{-3}/mA injected current. Locally the density will be higher, due to a radial density dependence which is found statistically. A pseudo-magnetic moment gives a good prediction of the reflection point in the r- and z-mirrors. The orthodox magnetic moment is less good in this respect. The implications of the computer results for an injection experiment in a cusped magnetic field are discussed. (auth)

31362 A MICROWAVE METHOD FOR PLASMA INSTABILITY STUDIES. B. E. Cherrington and L. Goldstein (Univ. of Illinois, Urbana). J. Nucl. Energy, Pt. C, 7: 263-75(May-June 1965).

A brief description is given of the use of low-power level microwave propagation techniques for the study of helical instabilities in magnetoplasmas. It is shown that this technique is well suited to the investigation of time varying plasma structures and instabilities in general. Rotational frequencies of various modes of the helical instability, determined as a function of the gas pressure and of the confining magnetic field intensities, are illustrated and are compared with theory. This method also reveals the conditions for the existence of configurations in decaying (afterglow) and rf-maintained magnetoplasmas which are similar to those found in dc-maintained magnetoplasmas. (auth)

31363 ANOMALOUS DAMPING OF HELICON WAVES IN A HOT PLASMA. J. P. Klozenberg (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.) and J. A. Lehane. J. Nucl. Energy, Pt. C, 7: 277-81(May-June 1965).

It is shown that anomalous damping of helicon waves propagating in a cylinder of hot plasma occurs when the sound speed is high enough. The damping mechanism is ohmic dissipation of currents flowing at the plasma surface. The theory is applied successfully to some recently published experimental results which up to now had been explained only by invoking a collisionless mechanism. (auth)

31364 FLUTE INSTABILITY FOR A GENERAL MIRROR EQUILIBRIUM. N. A. Krall (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Nucl. Energy, Pt. C, 7: 283-9(May-June 1965).

The low-frequency flute instability of a collisionless plasma in a curved magnetic field is examined in the low β, finite Larmor radius limit including the effects of temperature gradients, unequal electron-ion temperatures, unequal temperatures parallel and perpendicular to the field, and the superposition of cold plasma background on the hot plasma. These effects are found to modify the stability criterion, the growth rates, and can even reverse the direction of the phase velocity of the wave. (auth)

31365 LASER EFFECTS AND MICROINSTABILITIES IN A PLASMA. A. Samain (Euratom-CEA, Fontenay-aux-Roses, France). J. Nucl. Energy, Pt. C, 7: 291-3(May-June 1965). (In French)

A summary is given of an analysis of the phenomenon of release of the disordered energy of particles in an equilibrium plasma in a magnetic field. A collective regime can then be developed in the plasma, and the plasma equilibrium state appears unstable. The analysis uses a formalism describing the particle diffusion under the influence of the collective regime. It is clearly shown that the instabilities considered can occur when the distribution function of the particles is not a decreasing function of their energy. Laser effects occurring in a plasma are discussed briefly. (M.J.T.)

31366 THE STABILITY OF A FEEBLE PINCH. K. J. Whiteman (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.). J. Nucl. Energy, Pt. C, 7: 293-6 (May-June 1965).

Calculations are made which suggest a way of generating low-pressure plasmas, similar to the force-free paramagnetic model, whose stability can be tested. The stability calculations for the fields, using Newcomb's necessary and sufficient condition for stability of an infinitely conducting plasma, were carried out numerically, and the results are given. They show the possibility of finding a stable feeble pinch. (M.H.R.)

31367 PLASMA OSCILLATIONS IN A MAGNETIC FIELD. Som Krishan (Univ. of Delhi). J. Phys. Soc. Japan, 20: 566-9(Apr. 1965).

The small-amplitude plasma oscillations of a fully ionized plasma, in which collisions are neglected, in a constant external magnetic field are studied by expanding the velocity distribution about its equilibrium value. It is found that the case of a one-component electron plasma, the dispersion relation (which shows jumps in the frequency spectrum) for longitudinal oscillations in a plane perpendicular to the magnetic field has no solution for $\omega < \omega_c$ (ω and ω_c being the frequency of the wave and cyclotron frequency respectively), while for low values of β (= particle pressure/magnetic pressure) the system is stable to transverse oscillations in the high-frequency limit ($\omega > \omega_c$). (auth)

31368 ENERGY LOSSES BY A SEQUENCE OF FAST CHARGES AND BY A GYRATING CHARGE IN A MAGNETOPLASMA. Ryo Sugihara (Nagoya Univ., Japan) and Yukikazu Itikawa. J. Phys. Soc. Japan, 20: 591-7(Apr. 1965).

Some examples of resonance phenomena in a magnetoplasma are investigated. First, the energy loss by a sequence of fast charges moving across the magnetic field is calculated. In the resonance regions where the ratio of the plasma frequency ω_0 to the cyclotron frequency ω_H satisfies certain conditions, the energy-loss rate has a dominant term proportional to $\ln(v/v_T)$. Here, the velocity v of the charge of the sequence is assumed to be much larger than the thermal velocity, v_T, of the plasma. Next, the energy loss by a charge gyrating in a plane perpendicular to the magnetic field is calculated. The rate in this case is the same as that of the first case in the off-resonance regions, while in the resonance regions there is a little difference between the two cases. (auth)

31369 DIFFUSION AND LOW FREQUENCY OSCILLATION OF PLASMA IN A MAGNETIC FIELD. Kiyoshi Yatsui, Uichi Kubo, and Yoshio Inuishi (Osaka Univ.). J. Phys. Soc. Japan, 20: 621(Apr. 1965).

The diffusion rate of ions in a helium plasma at a pressure of 0.6 mm of Hg was studied with respect to a longitudinal magnetic field of 0 to 1000 gauss. An enhancement of the ambipolar diffusion coefficient above the value predicted by classical ambipolar diffusion theory was observed between 400 and 700 gauss. It was concluded that the enhancement is caused by low-frequency oscillations in the plasma. (D.C.W.)

31370 EXPERIMENTS ON NEGATIVE ABSORPTION IN A XENON PLASMA. Yasushi Terumichi, Toshitaka Idehara, Isao Takahashi, Hiroshi Kubo, and Kenji Mitani Kyoto Univ.). J. Phys. Soc. Japan, 20: 636-7(Apr. 1965).

An enhancement of an anomalous cyclotron emission from a xenon plasma in a magnetic field was observed when an external microwave signal was applied. This enhancement was attributed to the negative absorption of radiation in a weakly ionized plasma. (D.C.W.)

31371 A SYNTHESIZED PLASMA. Takayoshi Okuda and Kenzo Yamamoto (Nagoya Univ., Japan). Kakuyugo-Kenkyu, 14: 135-47(Feb. 1965).

A method of generating synthesized plasma is proposed.

The plasma is produced by mixing electron and ion beams, each of which is separately formed before entering a plasma-forming space. This method has an advantage that the mean energy, density and degree of neutrality of charge are controllable. A brief description of the synthesized plasma is given, which is mainly aimed at the investigation of various electrostatic instabilities and the thermalization processes. (NSA of Japan)

31372 CONDUCTIVITY OF A PARTIALLY IONIZED DRIFTING PLASMA. Takayoshi Okuda (Nagoya Univ., Japan). Kakuyugo-Kenkyu, 14: 148-61(Feb. 1965).

The conductivity of a partially ionized drifting plasma is discussed on the basis of the macroscopic transport equation. The resulting form of the conductivity differs from the ordinary one in that the perturbation of temperature leading to that of ionization plays a substantial role in the present case. The theory predicts that the effective dielectric permittivity deduced from the imaginary part of the conductivity may exceed unity. (NSA of Japan)

31373 INSTABILITIES BY HALL CURRENTS IN A WEAKLY IONIZED PLASMA. Susumu Saito and Noriyoshi Sato (Tohoku Univ., Sendai). Kakuyugo-Kenkyu, 14: 191-208(Feb. 1965). (In Japanese)

In a hot-cathode discharge tube with a coaxial electrode configuration, low-frequency oscillations (300 c/s–30 kc/s) propagating in the direction of $E \times B$ (where E is a radial electric field and B_0 is an external magnetic field) are observed when B_0 exceeds a low critical value. The gas used is Ar and Hg. The results of the experiments are in agreement with a theoretical analysis based on the fluid equations taking into account the collisions between charged and neutral particles. Oscillations are caused by an azimuthal macroscopic relative velocity between electrons and ions. For the case of low pressure, the oscillations seem to be ion acoustic waves. But these seem to be drift waves if the pressure is so high that the collision frequency is larger than the frequency of oscillations. (NSA of Japan)

31374 PLASMA FLUX AND ITS USES IN TREATMENT OF MATERIALS. Khasui. Kikai No Kenkyu, 15: No. 5, 15-18(1963). (In Japanese)

The theoretical bases of the plasma jet are presented, together with some data on its temperature and velocity. The use of plasma jets in treatment of materials is discussed. An optical method for measuring the jet temperature is described; results obtained by this method for an argon jet are included. Information on the relation of the input energy to the jet velocity and the dependence of the inter-electrode voltage on the argon flow rate is also included. (D.C.W.)

31375 ENERGY BALANCE OF A STATIONARY D-D FUSION REACTOR WITH CONSIDERATION OF DIFFERENT INPUT TIMES OF VARIOUS ION TYPES. H.-B. Valentini (Institut fur Magnetohydrodynamik, Jena, Ger.). Monatsber. Deut. Akad. Wiss. Berlin, 6: 920-6(1964). (In German)

Estimations on the energy balance of a d-d reactor were made in dependence on the temperature T, the product of the deuteron density N_D, and the mean input time τ of a charge carrier. In contrast to similar studies, different mean input times τ_i of various ion types in the plasma and different mean energies E with which the ions escape from the plasma were considered. The τ_i and E are determined through the type of magnetic confinement. It was shown that for certain τ_i and E and with neglect of the cyclotron beam and for a d-d reactor, there is a $T - N_D\tau$ range in which the energy release of the fast charged reaction products to the plasma can cover the energy loss through the bremsstrahlung and for heating the deuterium introduced. However, this range is at extraordinarily large $N_D\tau$ values in magnetic fields with suitable τ_i and E and at suitable temperatures. (tr-auth)

31376 ACCELERATION OF PROTONS DURING THE ION CYCLOTRON INSTABILITY. W. Bernstein, E. G. Murphy, M. Petravic, and D. R. Sweetman (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.). Nature, 206: 812-13(May 22, 1965).

The observation of high-energy protons produced in association with an ion cyclotron instability in the Phoenix neutral injection experiment at Culham is reported and discussed in relation to astrophysical phenomena. The observations may be of astrophysical significance since it has not been possible to identify the processes that lead to the production of the high-energy (0.1-100 Mev) ions and/or electrons observed in association with solar flares, the interaction between the solar wind and the Earth's magnetosphere, and perhaps shock fronts in the interplanetary medium. The results present a clear laboratory example of the efficient acceleration of particles to high energy by an instability for which the only energy source resides in the particle kinetic energy. (P.C.H.)

31377 A STUDY OF THE MECHANISM OF EXCITATION AND ENERGY EXCHANGE BY MEANS OF THE NONEQUILIBRIUM EMISSION SPECTRA PRODUCED BY A PULSED ELECTRIC FIELD IN A THERMAL PLASMA. I. THE MERCURY ARC. V. Ya. Aleksandrov, D. B. Gurevich, and I. V. Podmoshenskii. Opt. Spectry. (USSR) (English Transl.), 18: 107-10(Feb. 1965). Translated from Opt. i Spektroskopiya, 18: 190-7(Feb. 1965).

The plasma in the positive column of an arc was investigated by means of short (10^{-6} sec) high-voltage (3 to 6 kv) pulses. Oscillograms of the spectral lines showed that the additional radiation has two phases, nonequilibrium and equilibrium. The amplitude of the first phase decreases with increasing excitation and depends on the multiplicity of the level. An investigation of the nonequilibrium radiation showed that, in a mercury arc plasma at atmospheric pressure, the transfer of kinetic energy from electrons to atoms takes place through inelastic collisions, with electron excitation and stepped quenching by atoms, energy differences between the levels being small. In the nonequilibrium phase, the excitation temperature of isolated levels was close to the electron temperature, while the temperature of the high levels, which have a multiplet structure, was close to that of the atoms. The ionization temperature was also close to the atomic temperature. (auth)

31378 NONLINEAR EFFECTS IN THE TWO-STREAM INSTABILITY. J. P. Freidberg (Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.). Phys. Fluids, 8: 1031-8 (June 1965).

The problem of the nonlinear interaction of two cold interpenetrating electron and ion streams is treated. By seeking traveling-wave-type solutions to the nonlinear two-field system of equations, an amplitude dependent dispersion relation is obtained. An examination of the solutions and the dispersion relation indicates that there is a range of values for k, where the two-stream stability levels off before the onset of overtaking. (auth)

31379 TRIPLET CORRELATION FOR A PLASMA. Thomas O'Neil and Norman Rostoker (Univ. of California, San Diego, La Jolla). Phys. Fluids, 8: 1109-14(June 1965).

The three-body and two-body electron-correlation functions are calculated for a plasma in thermal equilibrium. The method involves convergent kinetic equations developed from the hierarchy by an expansion in $\epsilon = 1/4\pi nL_D^3$ which is carried to second order. The free energy determined by this method agrees with the previous result of Abé. (auth)

31380 SOME REMARKS ON PLASMA OSCILLATIONS AND THE KINETIC THEORY OF PLASMAS. C. H. Su (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 8: 1115-18(June 1965).

In the linearized Vlasov's equation, the solution to the distribution function can be split into two parts. The one which takes the form of the free-particle propagation makes the neglected term in the linearized theory grow in t. A method of coping with such difficulty is suggested. The method is applied to some very simple cases where in the long time limit one needs a modification of the first-order distribution function, but not the first-order electric field. In general, it is believed that both these quantities

have to be modified. The nature of higher-order corrections to the plasma kinetic equation is discussed. It is shown by the order of magnitude argument that the kinetic equation of a plasma cannot be extended beyond the first-order approximation with the adiabatic assumption of Bogoliubov. (auth)

31381 HIGH-FREQUENCY CONDUCTIVITY OF A PLASMA. T. L. Thourson and M. B. Lewis (Northwestern Univ., Evanston, Ill.). Phys. Fluids, 8: 1119-26(June 1965).

The high-frequency conductivity of a fully ionized plasma is calculated from the Bogoliubov-Born-Green-Kirkwood-Yvon equations for a plasma subjected to an applied field. These equations are used in the plasma limit but with the further approximation that those terms which lead to a screened Coulomb potential are replaced by a Coulomb potential with a range of the Debye length. This leads to a generalized Fokker-Planck equation, i.e., the collisional term has a more general space and time dependence than the usual Fokker-Planck equation. The equation is linearized about equilibrium and is solved by assuming that the effect of the field dominates the effect of the collisons. The effects of electron-electron as well as electron-ion collisions are considered and the results are calculated to second order in the wavenumber. (auth)

31382 HYDROMAGNETIC WAVES IN A PLASMA WITH FINITE LARMOR RADIUS. S. P. Talwar (Goodard Space Flight Center, Greenbelt, Md.). Phys. Fluids, 8: 1134-8 (June 1965).

The effect of finite Larmor radius and Larmor frequency on hydromagnetic waves in a plasma is investigated. It is concluded that the finite Larmor radius has considerable influence. A uniform rotation is also included in view of its astrophysical importance. (auth)

31383 STEADY-STATE PLASMA IN A PLANE. James P. Hurley (Univ. of California, Livermore). Phys. Fluids, 8: 1139-41(June 1965). (UCRL-12044)

A self-consistent solution of the steady-state magnetohydrodynamic equations for a charge neutral plasma in a plane is determined. In the absence of any external magnetic field a general solution for the magnetic field generated by the plasma is determined in terms of any prescribed pressure distribution. A solution is also obtained for certain singular external fields. (auth)

31384 EFFECTS OF LOW-FREQUENCY INSTABILITIES ON PLASMA SURFACE WAVES. L. S. Napoli, G. A. Swartz, and H. T. Wexler (Radio Corp. of America, Princeton, N. J.). Phys. Fluids, 8: 1142-5(June 1965).

Surface wave propagation experiments were performed on a fluctuating-density plasma column. The wave is a highly attenuated backward wave in which the energy is being transferred to sideband frequencies. The amplitude of the sideband increases as the wave progresses down the plasma column. The total energy of the composite wave is conserved except for a loss due to electron-neutral collisions. (auth)

31385 TEMPERATURE AND POWER MEASUREMENTS IN A PLASMA HEATED BY ABSORPTION OF ION CYCLOTRON WAVES. W. M. Hooke, M. A. Rothman, J. Sinnis, and J. Adam (Princeton Univ., N. J.). Phys. Fluids, 8: 1146-54(June 1965). (MATT-304)

A plasma in a magnetic mirror field is heated by means of an induction coil which generates plasma waves at a frequency near the gyrofrequency of the ions. Several hundred kilowatts of power are transmitted to the plasma. Ion energies in the neighborhood of 1 kev are observed in a small volume within the plasma. These energies are believed to be associated with ions trapped within a small magnetic mirror region following their acceleration by ion cyclotron damping of the waves. In a deuterium plasma production of neutrons is observed in association with these trapped ions. Ion energies of 200–300 ev are found throughout the total 10-liter plasma volume. The electron temperature is approximately 10 ev. Energy is lost from the plasma in times ranging from 30–50 μsec. This loss rate appears to result from particle losses as well as radiation from impurities. To explain the loss of energy it is not necessary to invoke an instability mechanism. (auth)

31386 MICROWAVE EMISSION FROM A FULLY IONIZED PLASMA. A. F. Kuckes and A. Y. Wong (Princeton Univ., N. J.). Phys. Fluids, 8: 1161-7(June 1965). (MATT-308)

The microwave radiation from a fully ionized thermal plasma was observed as a function of magnetic confining field and plasma density. The plasma generated radiation was found to be in substantial agreement with a theory based on the high frequency resistivity computed by Dawson and Oberman in the range of plasma density $0.01 < \omega_p^2/\omega^2 < 0.1$ and magnetic field $0.7 < \omega_c/\omega < 1.25$ ($\omega/2\pi = 35$ Gc/sec). (auth)

31387 PLASMA END LOSSES AND HEATING IN THE "LOW-PRESSURE" REGIME OF A THETA PINCH. E. M. Little, W. E. Quinn, and G. A. Sawyer (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 8: 1168-75(June 1965). (LA-DC-6792)

A neutron-producing plasma with ion energy ~3–4 kev has been produced at filling densities 10–50 μHg without negative bias magnetic fields in a 570-kJ theta pinch. Axial interferograms, taken with a ruby-laser-illuminated Mach-Zehnder interferometer show that a stable compressed plasma core exists throughout the magnetic half cycle with no ionized impurities outside the core, and no drift toward the wall. The interferograms give peak plasma densities of 2 to 5×10^{16} cm^{-3}, and also indicate a loss of particles as a function of time. Plasma containment times (e-folding times of N) before peak compression are 6 to 30 μsec. The observed loss rates are approximately in agreement with predictions of free flow through an orifice whose radius is equal to an ion Larmor radius. Soft x-ray measurements yield ~300 ev electron temperature for all filling pressures. Absolute intensities of the soft x-ray emissions show the impurity level to be <0.1%. The ion energy for the low-pressure regime deduced from pressure balance between plasma and magnetic field (assuming $\beta = 1$) is about a factor two higher than the ion energy deduced from the measured neutron yield for a Maxwell distribution. The discrepancy suggests that the distribution is more nearly monoenergetic than Maxwellian. (auth)

31388 DEVIATIONS FROM IONIZATION EQUILIBRIUM IN PLASMAS GENERATED BY ELECTRIC SHOCK TUBES. Ralph C. Isler and Donald E. Kerr (Johns Hopkins Univ., Baltimore). Phys. Fluids, 8: 1176-85(June 1965).

Temperatures and particle concentrations of helium plasmas generated in a linear electric shock tube of 15-mm dia were measured by spectroscopic techniques for initial pressures less than 1.0 torr. The ratio of doubly-charged to singly-charged ions is always found to be greater than the value expected in ionization equilibrium, implying that the measured luminosity arises from a decaying plasma that has been heated by the discharge rather than gas excited by a shock wave. Although measured plasma parameters at luminosity fronts are close to values calculated from the Rankine-Hugoniot equations in some experiments, the use of shock theory to calculate the state of the plasma does not seem justifiable. (auth)

31389 OBSERVED DWELLS IN CURRENT THROUGH A PULSED ARGON PLASMA. C. K. Manka and O. H. Zinke (Univ. of Arkansas, Fayetteville). Phys. Fluids, 8: 1186-8(June 1965).

Current dwells of durations from 1 to 38 μsec were observed with capacitor-discharge, argon plasmas pulsed in vacuo. The current during dwell is zero with a measuring error of 1 amp in contrast to large dwell currents observed in plasma of exploded wires. (auth)

31390 GUESSING KINETIC EQUATIONS. W. R. Chappell and R. J. Swenson (Univ. of Colorado, Boulder). Phys. Fluids, 8: 1195-7(June 1965).

The derivation of kinetic equations for a plasma interacting with an electromagnetic field by a rigorous method and a guessing method is discussed. The differences between the two methods are considered. A rather unexpected

term arises in the rigorous method from the bremsstrahlung contribution, and an attempt is made to show how the guessing method can be modified to obtain the unexpected term. (C.E.S.)

31391 AXIAL INJECTION INTO A MULTIPOLE GUIDE FIELD. R. G. Tuckfield, Jr. and F. R. Scott (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 8: 1197-9(June 1965). (GA-5416)

One of the major problems of plasma containment is purity. Several recent experiments which rely upon injection of a plasma produced by guns have shown containment limitations due to charge exchange arising in part from impurities and neutrals. These impurities usually originate in the region of the gun and contain a velocity spectrum similar to the plasma itself making separation difficult. Guiding and filtering by means of a static axial guide field has been attempted. Results obtained from injecting a plasma axially into a linear hexapole field are described. This field has the attractive features of zero axial field and cusp stability. (C.E.S.)

31392 INTERACTION OF POLARIZATION CURRENTS WITH A QUADRUPOLE MAGNETIC FIELD. Everet H. Beckner (Sandia Lab., Albuquerque, N. Mex.). Phys. Fluids, 8: 1199-1201(June 1965).

The interaction of two colliding plasma streams in a magnetic geometry consisting of a transverse and quadrupole field was studied. The phenomena relate directly to injection of plasma into minimum-B geometries. (C.E.S.)

31393 EXTERNAL FIELD REVERSAL IN A COLLISIONLESS THETA PINCH. K. S. Suh, G. Schmidt, and J. Futterman (Grumman Aircraft Eng. Corp., Bethpage, N. Y.). Phys. Fluids, 8: 1201-3(June 1965).

It was shown previously that a plasma undergoing field reversal will absorb a large amount of energy from the electromagnetic field. The motion of a single charged particle in a uniform field changes from monaxially encircling orbits before field reversal to orbits that encircle the axis following field reversal. It is assumed that every ion-electron pair in a macroscopically neutral plasma can be replaced by a fictitious positively charged "plasma particle" whose mass is given by the geometric mean of the ion and electron masses. Starting from the known behavior of a single charged particle, a self-consistent collision model consisting of the collective motion of many particles, which will afford some insight into the energy transfer mechanism, can be constructed. This model is used to calculate the final field and density distributions in the plasma. (C.E.S.)

31394 SIMPLE TOROIDAL MAGNETIC FIELD WITH NEGATIVE V''. J. B. Taylor (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.). Phys. Fluids, 8: 1203-5(June 1965).

The negative-V'' criterion, i.e., $d^2V/d\phi^2 < 0$, where V is the volume enclosed by a toroidal magnetic surface and ϕ is the toroidal flux which it encloses, is discussed. A negative-V'' configuration and a method for producing it are described. (C.E.S.)

31395 CRITICAL CORRELATIONS ASSOCIATED WITH HELICAL INSTABILITIES OF A PLASMA IN A MAGNETIC FIELD. Setsuo Ichimaru (Univ. of Illinois, Urbana). Phys. Fluids, 8: 1205-6(June 1965).

The existence of helical instabilities of a cylindrical plasma in a magnetic field under the action of an electric field applied parallel to the magnetic field is considered. The possibility of utilizing correlation measurements to investigate the onset and characteristics of such instabilities is discussed. As the plasma approaches from the region of stability a critical point corresponding to the onset of an instability, certain correlations which reflect the character of the instability become enormously enhanced. The correlations are of a hydrodynamic nature and may be measured directly by the usual probe techniques. (C.E.S.)

31396 AMBIPOLAR DIFFUSION IN A MAGNETIC FIELD. L. H. Holway, Jr. (Raytheon Co., Waltham, Mass.). Phys. Fluids, 8: 1207-8(June 1965).

In ambipolar diffusion without a magnetic field the congruence assumption, $\Gamma^+ = \Gamma^-$, is normally considered valid. The consequences of making this assumption when a magnetic field is present was recently explored (Phys. Fluids 6: 36(1963)). An attempt is made to evaluate one of these formulas and show that the congruence assumption leads to a surprising and usually unacceptable result. (C.E.S.)

31397 ON FLUCTUATIONS AND COHERENCE OF RADIATION IN CLASSICAL AND SEMI-CLASSICAL PLASMAS. B. U. Felderhof (Massachusetts Inst. of Tech., Cambridge). Physica, 31: 295-316(Mar. 1965).

The theory of thermal equilibrium fluctuations in plasmas is extended to include radiation. Expressions are derived for the correlation tensors of the electromagnetic field. (auth)

31398 KILOVOLT EXTRACTION OF DENSE ELECTRON BEAMS FROM SYNTHESIZED-PLASMA CATHODES. Arie L. Eichenbaum (Air Force Systems Command, Rome Air Development Center, Griffiss AFB, N. Y. and RCA Labs., Princeton, N. J.). Proc. IEEE (Inst. Elec. Electron. Engrs.), 53: 478-81(May 1965).

Electron beams with a continuous current density of 800 amp/cm^2 were extracted from a synthesized-plasma hollow cathode. The beams were accelerated up to potentials of 1.2 kv, through the potential of maximum ionization probability at about 16 v. There was no accompanying oscillation or gas breakdown. This high-voltage operation was made possible by collimating the cesium vapor entering the hollow cathode. The collimation, which was accomplished by use of a narrow slit at the "top" of the cathode, caused the vapor to flow along the cathode wall surface and away from the exit aperture. This minimized escape of neutrals into the high-voltage region. The cathode was tested for 200 hr without any signs of degradation. The cathode lifetime is predicted to be several thousand hours at the highest cathode temperature (2425°K) used in these studies. The extracted 0.030-in. diameter beam of 0.250-in. length had an electron temperature of less than twice the cathode temperature. Longer beams, such as would be used in actual microwave tubes, would require magnetic confinement. (auth)

31399 ON THE PRODUCTION OF HIGH ENERGY PARTICLES BY GIANT-PULSE LASERS. Walter Vali and Victor Vali (Boeing Scientific Research Labs., Seattle). Proc. IEEE (Inst. Elec. Electron. Engrs.), 53: 517-18 (May 1965).

It is shown that particles with energies higher than 10^{18}ev can be produced by the reflection of beams from presently available giant-pulse lasers by a plasma or electron cloud. (D.C.W.)

31400 THE LAGRANGIAN AND ASSOCIATED EQUATIONS OF CROSS-SECTIONAL FIELD DISTRIBUTION APPLIED TO INHOMOGENEOUS PLASMA WAVEGUIDES. K. E. Lonngren (Royal Inst. of Tech., Stockholm). Proc. IEEE (Inst. Elec. Electron. Engrs.), 53: 524-5(May 1965).

A Lagrangian method is outlined by which the equations of the cross-sectional field distribution can be obtained. The method is demonstrated by treating the determination of the cross-sectional field distribution in a circular waveguide filled with an inhomogeneous plasma with an infinite magnetic field in the direction of propagation. A homogeneous plasma in a finite-dimensional circular waveguide is also considered. (D.C.W.)

31401 REFLECTION OF ELECTROMAGNETIC WAVES BY A SEMI-INFINITE COMPRESSIBLE PLASMA. R. Burman (Victoria Univ., Wellington, New Zealand). Proc. IEEE (Inst. Elec. Electron. Engrs.), 53: 525-6(May 1965).

The reflection of electromagnetic waves at a plane interface between a dielectric and a compressible plasma is treated for the case in which both regions are homogeneous and isotropic. The excitation and propagation of electron acoustic waves in the plasma region are considered. (D.C.W.)

31402 WAVES AND NOISE IN A PLASMA COLUMN. P. F. Little and H. G. Jones (Culham Lab., Abingdon, Berks, Eng.). Proc. Phys. Soc. (London), 85: 979-96(May 1965).

In the positive column of a low-pressure mercury arc, measurements of the transmission of electroacoustic waves are made in small and zero axial magnetic fields. Externally excited and self-excited waves are shown to propagate similarly; a low-frequency cut-off in transmission appears for both at about 20 kc/s. Over the lower part of the frequency range, a simple theory using the measured steady-state parameters of the discharge fits the observations, usually within the combined experimental errors (±20%). Above 40 kc/s the slope of the experimental dispersion curve falls sharply; this is the upper limit at which an external exciter coil is effective in a magnetic field, and at this frequency the exciter is least effective in zero field. The change in wave character is not understood. The wave damping is less than that expected from the rate at which ions strike the wall. The boundary conditions are not clear. (auth)

31403 SPECTROSCOPIC MEASUREMENT OF PLASMA ROTATION IN A PENNING DISCHARGE. H. W. Drawin and M. Fumelli (Euratom-CEA, Fontenay-aux-Roses, France). Proc. Phys. Soc. (London), 85: 997-1005(May 1965).

Balmer lines emitted from a Penning discharge in hydrogen gas show a Doppler shift indicating rotation around the axis of the discharge column. This effect is explained as a result of the charge exchange collisions of the drifting plasma ions with the neutral atoms, and the fast neutral particle thus produced being excited by the plasma electrons. Accordingly this rotation is identified with the drift motion of the plasma. The velocity of rotation v_{rot} is obtained as a function of radius from the measured Doppler shifts for two values of the confining magnetic field strength B_z. The results show that for plasma layers with radial distances r smaller than or equal to the radius of the hollow anode cylinder, that means inside a tube which contains radial currents I_r, the rotational speed v_{rot} can be expressed by the following formula: $v_{rot} = (I_r B_z/n_i m_i n_0 \sigma_{coll} 2\pi r L)^{\frac{1}{2}}$. A derivation of this expression is given. (auth)

31404 EXCITATION OF PLASMA WAVES PROPAGATING TRANSVERSE TO THE UNIFORM EXTERNAL MAGNETIC FIELD. Momota, Hiromu (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 33: 394-401(Mar. 1965).

Using the perturbation method, the motion of an electron in a perturbed longitudinal plasma wave is studied. The wavelength of the wave is assumed to be small compared with the electron Larmor radius. The criterion for excitation and damping of the plasma wave is then obtained. Frequencies of waves which are excited are found to be nearly equal to integral multiples of the electron cyclotron frequency. The results are applied to the explanation of the phenomenon of high cyclotron harmonics radiation. (auth)

31405 ON THE KINETIC THEORY OF UNSTABLE PLASMAS. Nishikawa, Kyoji; Osaka, Yukio (Tokyo Univ. and Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 33: 402-22(Mar. 1965).

The evolution of a spatially homogeneous unstable plasma is investigated. A complete expression for the plasma wave contributions to the kinetic equation for $f(v;t)$ (the velocity distribution) is derived under the usual plasma approximations (mode-coupling effects are ignored) and in the treatment of $f(v;t)$ as slowly varying in time. The equation has a characteristic dependence on the initial correlation. It can alternatively be written in the form of simultaneous equations which, in the limit of weak instability, agree in form with the Pines-Schrieffer equations. The applicability of the various forms of the equation is discussed. In particular, it is shown that the stabilization process can be studied by the simultaneous equations derived, but not by any kinetic equation for $f(v;t)$ obtainable with the ring approximation. (auth)

31406 INVESTIGATION OF PLASMA INSTABILITY . B. B. Kadomtsev. Vestn. Akad. Nauk SSSR, No. 2, 47-50 (Feb. 1965). (In Russian)

A plasma is a very mobile, unstable medium in which the charged particles are united into one whole due to the far-acting nature of the electromagnetic forces. Even a small oscillation can upset the thermodynamic equilibrium. Plasma effects are highly sensitive to a number of parameters in any concrete situation. Hence, kinetic calculations are not readily applicable to new concrete conditions. Plasma instabilities can be divided into magnetohydrodynamic (MHD) and into kinetic instabilities. The MHD instabilities of a plasma loop with flow in a longitudinal magnetic field are spiral and chute instabilities. The spiral instability can be stabilized by a sufficiently strong longitudinal magnetic field. The chute instability can be stabilized by creating a magnetic configuration in which the magnetic field increases on the average on approaching the periphery. A real plasma with a temperature of 10 to 100 ev is also subjected to a number of dissipative instabilities due to a finite conductivity, diffusion, thermal conductivity and viscosity. Drift instabilities can be readily stabilized by the "crossing of force lines." Weak turbulence of a plasma has been described theoretically, but strong turbulence is much more difficult to handle. (TTT)

31407 ON THE DRIFT OSCILLATION OF HETEROGENEOUS PLASMA SPREADING ACROSS OUTER MAGNETIC FIELD. D. P. Kostomarov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 68-74(Nov.-Dec. 1964). (In Russian)

The normal waves being propagated in heterogeneous plasma across an external magnetic field were investigated. The drift oscillations were studied. It was shown that these oscillations can be unstable. By means of the perturbation theory, increments were calculated. (tr-auth)

31408 ELECTRON DENSITY DETERMINATIONS WITH A MICROWAVE BRIDGE IN WEAKLY IONIZED PLASMA. H. H. Broemer and F. Doebler (Technische Hochschule, Brunswick). Z. Naturforsch., 20a: 599-606(Apr. 1965). (In German)

A microwave bridge, similar to the optical Jamin interferometer, was developed in order to determine the electron density in weakly ionized decaying plasmas. The discharge vessel was located in the open space between two horn antennas. A rather homogeneous excitation was accomplished by using an electrodeless high frequency (f = 13.6 MHz) discharge. Contrary to the common practice of using phase displacements several times of π, only very small displacements of the signal phase, traversing the plasma, were used. The dimensions of the discharge vessel and the frequency of the microwave (f = 23 GHz; λ = 1.3 cm) were properly chosen in order to have proportionality between the mean electron density and the oscilloscope trace. The range of electron-density investigated was about 10^8 to 10^{10} cm^{-3}. The operation of the bridge was investigated during the afterglow of a decaying nitrogen plasma. Simultaneous optical observations showed that the intensity of the first negative bands of $N_2^+(B^2\Sigma_u^+ - X^2\Sigma_g^+)$ is nearly proportional to the electron density. Using this correlation, the electron density profile across the discharge vessel was evaluated. It could be shown that the time dependence of the electron density in the afterglow changes strongly within the discharge vessel. A comparison between the measurements of the electron density and the optical observations showed that the microwave bridge is able to give some details of the electron density profile across the discharge vessel, in spite of the large wavelength used, compared with the dimensions of the discharge vessel. (auth)

31409 THE PRODUCTION AND INVESTIGATION OF VERY DENSE MAGNETICALLY COMPRESSED PLASMA. Hartmut Zwicker and Uwe Schumacher (Technische Hochschule, Hanover). Z. Physik, 183: 453-71(1965). (In German)

In the framework of the question of how far the realizable range of state of completely ionized plasma can be extended to higher densities with the help of the Z pinch, a study was made in the pressure range between 0.3 and 11 torr to de-

termine how temperature and particle density in the compressed column change with increasing initial pressure of H_2 and He. For the measurement of the entropy, a special spectroscopic method designed for dense plasma was used that takes into consideration reabsorption in the column. It was shown that for a given collision arrangement an optimum initial pressure exists in which in the compression phase the temperature assumes the same value as at smaller pressures, but a maximum value of the particle density in the compressed column is attained which in the present case was 3.2×10^{19} cm^{-3} for He. The typical behavior of the particle density with increasing initial pressure is explained on the basis of measurements of the current density distribution from the characteristic discharge of the Z pinch at higher initial pressures. (tr-auth)

31410 NON-LINEAR PROBLEM ON COLLISIONS OF CHARGED PLASMA CLOUDS. V. A. Enal'skii and V. S. Imshennik. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 1, 3-13 (Jan.-Feb. 1965). (In Russian)

Numerical experiments are performed for the collision of two infinite-plane clouds of hydrogen plasma, each of thickness L, moving together with a unit relative velocity. The densities of the clouds are low enough so that collisions, the magnetic fields, and first-order interactions of the electric fields may be neglected. It is also assumed that the relative velocity of the two clouds is much greater than the thermal velocities of either the protons or the electrons. The equations are developed for the motion of the individual protons and electrons, and are solved by Monte Carlo methods. The results show that as soon as the two clouds meet at time t = 0, nonlinear interactions occur. During the interaction time ($t \leq 2L$), about half the kinetic energy is translated into oscillatory motion of the electrons. After the two clouds have passed ($t > 2L$) the electrons in both clouds are still oscillating, and have gained energy at the expense of the protons. (TTT)

31411 ATTENUATION OF PLASMA WAVES. R. K. Mazitov. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 1, 27-31 (Jan.-Feb. 1965). (In Russian)

Mechanisms are considered for forming a plateau for the electron-velocity distribution function f(v) in the attenuation of weak monochromatic plasma waves. At time t = 0 it is assumed that f(v) is Maxwellian. Square-wave and sinusoidal shapes are considered for the plasma-wave potential ϕ. In the collisionless model of the plasma, the plateau in f(v) is obtained from resonance interactions, at which point the wave is not attenuated; but the wave is attenuated if collisions are considered. For the square-wave ϕ, the equation for the energy in the plasma wave has the shape of a damped sine wave in time. The coefficient of the damping term is the same as obtained by Landau. For the sinusoidal ϕ the energy in the plasma wave can be expressed in terms of elliptic integrals. In this case, at large t, the energy in the plasma wave is proportional to $1/t^2$. (TTT)

31412 HIGH-FREQUENCY CONDUCTANCE OF NON-ISOTHERMAL, FULLY IONIZED PLASMA. A. R. Shister. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 50-6(Nov.-Dec. 1964). (In Russian)

An approximation expression is obtained for the high-frequency conductance of a plasma when the electron temperature appreciably exceeds the ion temperature and the frequency of the external field is higher than the frequency of the ion Langmuir oscillations. (ATD)

31413 MOTION OF CHARGED PARTICLES IN PLASMA UNDER THE INFLUENCE OF A MAGNETOHYDRODYNAMIC SHOCK WAVE. V. P. Korobeynikov and S. P. Lomnev. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 89-92(Nov.-Dec. 1964). (In Russian)

The problem of a magnetohydrodynamic shock wave propagating in a gas is considered. It is assumed that the gas is calm in front of the shock wave and that all parameters of the medium are known. Behind the shock wave front some variation of the gas parameters takes place with respect to velocity, density, motion, and magnetic field. At time $t = t_0$ the shock wave front is penetrated by a charged particle possessing relatively high energy. It is required to determine the path of the particle and if possible to explain the mechanism of its acceleration induced by energy and magnetic fields. Shock wave propagation in perfect gas is considered for cases of a planar shock wave travelling at constant velocity D, and a spherical shock wave generated by a strong instantaneous explosion in a perfectly conducting gas with initial field H_1. (ATD)

31414 SPACE-CHARGE LIMIT IN AN ELECTRON PULSE IN THE EFFECT OF MULTIPLICATION. V. I. Petrunin and M. F. Vorgushin. p.25-30 of "Elektrofizicheskaya Apparatura. Sbornik Statei, Vypusk 2." Moscow, Atomizdat, 1964. (In Russian)

Space-charge effects limit the density of an electron pulse ρ which may be formed by a low-voltage resonance discharge. The oscillating motion of the electron pulse in the gap of finite size leads to an oscillating potential well when the space-charge density exceeds a certain limit. If the depth of the potential well of the pulse at the moment it strikes bottom of the resonator gap exceeds the energy of the secondary electrons emitted from the bottom, the secondary electrons will be lost until the potential energy of the barrier of the pulse becomes lower than the energy of the seconday electrons. It is assumed that the stationary pulse obeys Langmuir's law. The Poisson equations are solved for the potential barrier, assuming that $\rho = \rho_0$ inside the pulse and that $\rho = 0$ outside the pulse and requiring that the potential and its gradient be continuous across the pulse barrier. It is shown that the electron flux is optimized by choosing the material at the bottom of the resonator gap to have the largest value of $\delta\sqrt{V}$, where δ is the secondary-electron emission coefficient and V is the voltage where δ is a maximum; that the current density is proportional to ω^2, where ω is the resonator frequency; and that the flux is proportional to $(2n-1)^{-2}$, where n is the resonator multiplication factor. (TTT)

31415 ELECTRIC DISCHARGE CONFIGURATION IN "OMEGA" INSTALLATION. Yu. G. Bobrov and A. V. Komin. p.63-70 of "Elektrofizicheskaya Apparatura. Sbornik Statei, Vypusk 2." Moscow, Atomizdat, 1964. (In Russian)

High-frequency discharges (15 to 26 Mc) were superimposed on the usual point discharge in the "Omega" device to study the effect of reducing the instabilities usually observed in a point discharge. Argon gas was ionized at pressures from 10^{-3} to 10^{-1} mm Hg in a copper chamber 45 mm diameter and 230 mm between discharge plates. Ionization pulses of up to 700 μsec at currents up to 1,500 amp were obtained in a magnetic field of 0 to 1000 gauss. A pinch effect was observed. A h-f discharge was superimposed at various times before and after the point discharge, but had no observed effect on the point discharge operating conditions. It was found that the point discharge occurred, not between the two electrodes, but between the inner electrode and the chamber walls. No satisfactory explanation was found for this phenomenon. (TTT)

31416 L'ENERGIE THERMONUCLEAIRE. (Thermonuclear Energy). Jean Crussard. Paris, Editions Fayard, 1963. 158p.

An exposition as simple as possible, but with rigid scientific validity, is presented on the theory of thermonuclear energy. The principle of thermonuclear fusion, thermonuclear energy of the stars, thermonuclear bomb, controlled fusion, and its possible future development and use are considered. (J.S.R.)

31417 A MICROSCOPIC TREATMENT OF CLASSICAL CONTAINMENT IN THE STELLARATOR. A. S. Bishop and Craig G. Smith. 17p. (CONF-758-18)

From American Physical Society Meeting, New York, Jan. 1965.

An analysis of plasma containment in a stellarator is outlined in which the trajectories of the guiding-center motion of individual particles are considered. The

stellarator model is a torus, with no straight sections and with continuously wound helical fields; the magnetic surfaces are assumed to be circular. Results are presented for a device with an electric field varying linearly with radius. (D.C.W.)

31418 APPARATUS FOR USE IN THE EXAMINATION OF PLASMAS. (to European Atomic Energy Community). British Patent 983,712. Feb. 17, 1965. Priority date Mar. 30, 1961, France.

An apparatus is described for the mass analysis of plasmas, even those of very short life. The apparatus is made up of a means for producing the plasma, a mass spectrometer of the "time-of-flight" type, and an electron multiplier system. The spectrometer includes two electrodes in succession in the path of ions emitted by the plasma and spaced from the source of plasma production. An ion-accelerating voltage of the order of 5 kv is applied between the electrodes for a period of tenths of a microsecond. The target for the accelerated ions is spaced at least 2 m from the electrodes in the path of the ions and forms the first electrode of the electron multiplier system. (B.L.M.)

31419 METHOD AND DEVICE FOR OBTAINING CONTROLLED NUCLEAR FUSION. Karl Nowak. British Patent 983,753. Feb. 17, 1965. Priority date June 8, 1960, Austria.

A method and apparatus are described for producing a controlled nuclear fusion in which two beams of accelerated electrically active particles are directed in opposite directions towards one another in a tubular reaction chamber. Windings surround the chamber so that the beams are magnetically constrained to follow spiral paths. An accelerating potential applied to the particles, i.e., deuterium or tritium ions, imparts an energy in the range of 10 – 100 kev to the particles. A cathode and anode arranged in a recessed portion of the tube establish an electron discharge transversely of the beams where they meet. A cooling jacket located outside the electromagnetic windings dissipates the energy of the reaction. (B.L.M.)

31420 IMPROVEMENTS IN OR RELATING TO METHODS OF GENERATING MASSES OF HOT IONIZED GAS. (to The M-O Valve Co. Ltd.). British Patent 984,158. Feb. 24, 1965. Filed Nov. 14, 1962.

An apparatus and method for generating a mass of hot ionized gas includes an evacuated vessel and means for producing two streams of gas ions within the vessel. One stream of ions travels over a given path, and over a considerable distance along the path the second stream of ions is propagated, but at a lower phase velocity. The second stream of ions is so generated that a fast wave in the second stream has the same phase velocity as a slow wave in the first stream resulting in an overall amplification of the waves in the system. (B.L.M.)

31421 IMPROVEMENTS IN OR RELATING TO THE CONTROL OF CURRENT IN PLASMA. (to AVCO Corp.). British Patent 987,590. Mar. 31, 1965. Priority date June 1, 1961, United States.

A method and apparatus are described for controlling the flow of conduction current in a plasma by selectively, over different periods of time, permitting and preventing the flow of Hall current longitudinally through the plasma. The interruption of the current flow is effected when the Hall current flowing longitudinally through at least a portion of the plasma is about maximum. The apparatus includes a plurality of electrodes spaced from each other within the container for the plasma. The electrodes are arranged in pairs located opposite each other. Opposed electrodes of each pair are connected to each other by interruptable circuit means. A further interruptable connection either is provided between the interruptable circuit means of a downstream pair of electrodes and the interruptable circuit means of an upstream pair of electrodes or between corresponding ones of separate terminal electrodes arranged in opposed pairs. The apparatus may be used to take an MHD generator on or off the line, control its current output, or vary its output current to provide a wave form that approaches that of a sine wave. (B.L.M.)

31422 ELECTRODELESS DEVICE FOR THE GENERATION AND/OR ACCELERATION OF PLASMOIDS IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Walter Hertz (to Siemens-Schuckertwerke Aktiengesellschaft). German Patent 1,189,664. Mar. 25 1965. Filed Dec. 21, 1963.

In the electrodeless device for the generation and/or acceleration of plasmoids in crossed electric and magnetic fields the induction coil surrounding a discharge tube of insulating material and generating a ring discharge with the tube is inserted into a recess in the face of the outer, cylindrical limb of a pot-shaped magnet that surrounds one closed end of the tube. A field coil is wound on the middle limb of the magnet. (Gmelin Inst.)

Shielding

Refer also to abstract 30009.

31423 (LA-DC-6756) USE OF DISCRETE ORDINATES METHODS FOR SOLUTION OF PHOTON TRANSPORT PROBLEMS. K. D. Lathrop (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 20p. (CONF-650501-9). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From the Application of Computing Methods to Reactor Problems, Argonne, Ill.

The anisotropic scattering approximation developed for a multigroup discrete-ordinates representation of photon transport is described; it uses an N + 1 term Legendre polynomial expansion of the Boltzmann equation. The DTF code, a one-dimensional multigroup discrete-ordinates code, was modified to accept multigroup transfer cross sections for an arbitrary order of Legendre scattering approximation and to compute the angular moments. A code, GAMLEG, was developed to prepare multigroup photon cross sections for use in the scattering approximation. Various numerical problems to test the system were performed, including computations of the percentage of photons penetration a 10-cm iron slab, of photon flux in a spherical reactor mockup, and of fluxes from energy distributed sources, and results are compared with those from previous computer calculations. (M.J.T.)

31424 COMMENT ON "MASS AND MAGNETIC DIPOLE SHIELDING AGAINST ELECTRONS OF THE ARTIFICIAL RADIATION BELT." R. H. Levy (Avco-Everett Research Lab., Everett, Mass.). AIAA (Am. Inst. Aeron. Astronaut.) J., 3: 988-9(May 1965).

The mass of structural material and superconductor required for magnetic shielding against 10-Mev electrons was studied theoretically. A relation between the shielded volume and the mass of superconductor was obtained. It was found that the structural weight is a negligible fraction of the superconductor weight. (D.C.W.)

31425 PENETRATION OF REACTOR NEUTRON EMISSION THROUGH ANHYDROUS MEDIA. S. G. Thypin, B. I. Sinitsyn, and V. G. Daruga. At. Energ. (USSR), 18: 350-7(Apr. 1965). (In Russian)

Theoretical and experimental studies were made of penetration of neutron through anhydrous homogeneous materials and mixtures. Data on the neutron relaxation length in various energy groups are discussed. It is shown that under certain assumption the attenuation of the upper energy group of neutrons ($E_n \geq 3$ Mev) in anhydrous shielding materials may be found by simple empiric expressions using universal constants. (tr-auth)

31426 INDEX OF THE WEIGHT EFFICIENCY OF TWO-COMPONENT MATERIALS USED AS SHIELDING AGAINST NEUTRON AND γ EMISSIONS. G. A. Lisochkin and F. A. Predovskii. At. Energ. (USSR), 18: 408-9(Apr. 1965). (In Russian)

Index of the weight efficiency of two component materials used as a shielding against neutron and γ emissions was calculated considering total weight of both components which results in equal shielding from neutron and γ emissions. Indices for various possible material combinations are tabulated. (R.V.J.)

31427 NUMERICAL CALCULATIONS OF γ-QUANTA PASSAGE THROUGH MATTER. V. S. Galishev. At. Energ. (USSR), 18: 415(Apr. 1965). (In Russian)

Analytical calculations made by V. S. Galishev (Atom. Energiya, 14, 453 (1963)) on penetration and reflection of γ rays in plane-parallel layers of finite thickness were used for calculating the energy factor accumulated by 10-Mev γ radiation passing through a lead absorber. The results of the calculations compared with the data calculated by Monte-Carlo method showed good agreement for the cases with small thickness layers ($\mu_0 a$ = 0.5 to 1). However, for thick layers ($\mu_0 a$ = 2 to 4) the calculations showed too low magnitudes indicating the impossibility of using the method with relatively thick absorbers. (R.V.J.)

31428 MONTE CARLO CALCULATION OF THE TRANSMISSION OF GAMMA RAYS FROM A LINE ISOTROPIC SOURCE THROUGH STEEL PIPES. Iwao Umeda. Nippon Kokan Giho, No. 32, 52-60(Feb. 1965). (In Japanese)

A nuclear-powered ship has radioactive piping which constitutes an assembly of many line sources. The steel pipes used in such piping act as an effective shield against these line sources. In order to quantitatively determine such shielding properties, the transmission of gamma rays from the line isotropic sources through steel pipes was calculated by the Monte Carlo method. The procedure of calculation is described, and examples of calculation of the build-up factors, the energy spectra, and the collision numbers of gamma rays transmitted through the pipe are cited for the cases where ^{60}Co and ^{137}Cs line sources are shielded with steel pipes having a wall thickness of 10.0 ~ 51.5 mm. The case histories of 5,000 photons for ^{60}Co and 10,000 photons for ^{137}Cs were followed on an IBM 7090 computer. The comparison between calculated values and experimental results showed a good agreement, and it was observed that singly scattered gamma rays prevail even at a pipe thickness of several mean free paths. (NSA of Japan)

31429 INTERPOLATED ENERGY DISTRIBUTIONS OF Hg^{203} GAMMA RAYS SCATTERED IN SAND. A. Schaarschmidt (Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main). Nucl. Instr. Methods, 34: 325-7(June 1965).

Using the moments-method spectra of Goldstein and Wilkins the energy distributions of the number flux of multiple scattered γ rays in quartz sand, starting from a point isotropic source of ^{203}Hg, are evaluated by interpolation for 10, 20, 30 ... 110 cm distance from the source. Also the curves for the corresponding number, energy and dose build-up factors are given. (auth)

31430 STUDY ON AN ANALYTICAL REPRESENTATION OF THE NEUTRON FLUX IN PLATE LAMINATIONS. Karl-Heinz Mueller (CCR Euratom, Ispra, Italy). Nukleonik, 6: 271-4(1964). (In German) (EUR-876.d)

The direct variation-calculus method, if applied to the Boltzmann neutron transport equation, enables analytical expressions to be formulated by means of which the neutron distribution in the reactor can be clearly described. For the unidimensional plate lamination, three methods which lend themselves readily to the solution of shielding questions are adduced and applied. (auth)

31431 MAGNETOFLUIDODYNAMICS TRANSPORT EQUATION APPLIED TO THE CALCULATION OF HEAT DEVELOPMENT IN SPHERICAL AND CYLINDRICAL γ-RAY SHIELDS. Vito Lozupone (Universita, Rome). Ric. Sci. Rend., Sez. A(2), 6: 729-52(Dec. 1964). (In Italian)

A brief description is given of the technique of deduction of the Boltzmann transport equation as used in magnetofluidodynamics for distribution functions relative to electrons, ions, and neutral particles. In this latter case, assuming that the monokinetic particles interact with a purely absorbent isotropic and homogeneous medium in stationary conditions, the collision term is determined. The equation obtained is applied in the examination of the attenuation of the monochromatic gamma radiation, calculating the locally developed heat in the spherically and cylindrically symmetric screens with different hypotheses for the angular distribution of the incident radiation. (auth)

31432 THE FACTOR OF DOSE ACCUMULATION FOR A POINT ISOTROPIC SOURCE IN BARRIER GEOMETRY. L. R. Kimel. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 16-19(1964). (In Russian)

It was previously shown that the energy factor of accumulation in barrier geometry for a plane unidirectional source is related to the corresponding accumulation factor B within an infinite medium by the formula $B_g(Z, h\nu, \mu d) = \delta(h\nu, Z) B_\infty (Z, h\nu, \mu d)$. This formula may prove useful in calculations of real shielding structures. The values of the $\delta(h\nu, Z)$ factor and the magnitudes of the dose accumulation factors for a point isotropic source in barrier geometry were tabulated for H_2O, Al, Fe, Sn, and Pb in the range from 0.5 to 10.0 Mev. (CFSTI)

31433 DISTRIBUTION FUNCTION OF A POINT UNIDIRECTIONAL SOURCE WITH 2.76-Mev INITIAL GAMMA QUANTA ENERGY IN ALUMINUM, IRON, AND LEAD. A. M. Panchenko. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 20-4(1964). (In Russian)

The distribution functions of a point unidirectional source with 2.76-Mev initial γ quanta energy in Al, Fe, and Pb are presented in graphs and a table of energy accumulation factors for a plane unidirectional source is given. (CFSTI)

31434 THE USE OF REMOVAL CROSS SECTIONS DURING THE CALCULATION OF NEUTRON SHIELDING. L. R. Kimel and V. P. Mashkovich. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 25-9(1964). (In Russian)

B. I. Sinitsyn and S. G. Ysypin (Atomnaya energiya, 12(4): 306(1962)) discovered that in the case of fission neutrons in elementary media, the measured relaxation length for detections with energy thresholds of about 3 Mev coincides with the one calculated on the basis of removal cross sections (AECD-3978, 1955). The applicability of these procedures to the attenuation of fast neutrons in media representing a mixture of elements (e.g., concrete) was studied. In the case of three different types of concrete, calculations using the law of addition showed excellent agreement with experimental data concerning neutron cross sections for energies above 3 Mev (HW-64774, July 15, 1960). A table of macroscopic removal cross sections in 31 elements and 48 compounds compiled from various references is presented. (CFSTI)

31435 A STUDY OF THE RADIATION FIELD FROM POINT UNIDIRECTIONAL SOURCES. (BRIEF SURVEY). A. M. Panchenko. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 45-54 (1964). (In Russian)

After comparing the results previously published it was concluded that the experimental and theoretical data on the distribution of γ rays from collimated sources refer basically to water and air. The greatest attention was devoted to studies of the spatial radiation distribution, while data characterizing the spectral angular distribution are almost nonexistent. The contribution of the scattered radiation within the primary beam was concluded to be negligibly small. The shape of the distribution function within the beam depended on the radiation scattered within the collimator whenever its diameter exceeded 1 cm and the collimation angle was larger than 1°. The spatial distribution of the scattered gamma radiation was basically exponential. A similar pattern was found in the case of fission neutrons in water and iron. (CFSTI)

31436 MEASUREMENT OF THE SPECTRAL DISTRIBUTION OF GAMMA RADIATION FROM A 0.662 Mev

POINT UNIDIRECTIONAL SOURCE SCATTERED IN WATER. L. R. Kimel, V. A. Klimanov, and O. I. Borishov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 55-64(1964). (In Russian)

Studies were made of the scattering in water of a 0.662-Mev thin gamma beam. To avoid large scale perturbations due to the atomic numbers and densities of inorganic scintillators, the authors used anthracene, whose atomic number and density are close to those of water. A description of the construction and operation of the experimental setup is followed by a theoretical discussion of various necessary corrections. The procedures for measurement of soft spectral components of scattered γ rays were tested by measuring the radiation from a point ^{60}Co source at a distance of 4 mean free paths from the source. The results agreed within 25% with the theoretically calculated values of Goldstein and Wilkins (NYO-3075). The differential energy spectra of 0.662-Mev γ quanta scattered in water are shown. A characteristic feature of the diagrams is the appearance of peaks due to single and multiple scattering. (CFSTI)

31437 SOME PROBLEMS OF RADIATION WITHIN AN INFINITE MEDIUM CONTAINING UNIFORMLY DISTRIBUTED ISOTROPIC SOURCES. V. V. Pavlov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 82-8(1964). (In Russian)

A comprehensive study was made of radiation within an infinite medium containing uniformly distributed isotropic sources. It was previously concluded by Gorshkov that in the case of extended sources acting from all sides towards the observer, the radiation intensity (aqueous medium, ^{60}Co source) is approximately twice the one calculated without taking into account secondary rays while carrying out measurements with conventional devices. It was also considered highly probable that the coefficient taking care of secondary rays must be directly proportional to the coefficient of true γ absorption within the medium under consideration. Consequently, the magnitude of the fraction of energy (and of the related quantities) absorbed from the unscattered radiation was investigated. The errors introduced by calculating the absorbed energy on the basis of the accumulation factor of a point isotropic source within an infinite medium given in the form of a sum of two exponentials are discussed. The errors in the calculation of the dose and absorbed radiation are tabulated. (CFSTI)

31438 THE CALCULATION OF THE FLOW OF GAMMA RADIATION ENERGY AT THE EXIT FROM A STEPWISE CYLINDRICAL CHANNEL. V. V. Pavlov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 89-94(1964). (In Russian)

If the step section of a stepwise cylindrical channel is sufficiently large, calculation of the energy outflow at the exit of the channel may be reduced to the calculation of a flow at the exit from a "pit". The calculation assumes that the γ source is monochromatic, that the radiation is incident perpendicularly to the barrier, and that the pit's walls are absolutely black. The necessary values of the semiempirical constants were taken from the work of A. B. Larichev. The results showed that for pit radii between 5 and 10 cm, penetrating half the thickness of concrete barriers 1.5 to 2 m thick, the energy flow depends on the square of the pit's radius. The results are plotted in the form of graphs. (CFSTI)

31439 CURRENTS, ENERGY FLOWS, AND DOSES FROM THE SURFACE OF A SEMI-INFINITE MEDIUM CONTAINING UNIFORMLY DISTRIBUTED ISOTROPIC SOURCES OF GAMMA RADIATION. V. V. Pavlov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 95-100(1964). (In Russian)

If an infinite medium with uniformly distributed isotropic sources is considered as the sum of two semi-infinite planes, the energy current within the infinite medium can be related to the energy current at the surface of the semi-infinite medium by the formula $j_{inf} = j_{semi\text{-}inf} + A_j j_{semi\text{-}inf}$, where $A_j j_{semi\text{-}inf}$ is the energy emitted by the unit surface of one semi-infinite region and reflected by the other. Multiple reflections are neglected and the single-reflection calculations yield $A_j = 0.13$ at 1 Mev and 0.09 at 2 Mev. Analogous equations for energy flow lead to a semi-infinite plane A (albedo) = 0.19 at 1 Mev and 0.12 at 2 Mev. The calculations utilize the isotropic source albedo data from Berger and Raso. The equations for the semi-infinite medium doses were also derived. (CFSTI)

31440 THE PROCESSING OF SPECTRA FROM MONOENERGETIC NEUTRONS BEHIND WATER SHIELDING USING THE METHOD OF COUNTING EFFICIENCIES. G. G. Doroshenko, I. R. Barabanov, and V. A. Fedorov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 101-5(1964). (In Russian)

The method of counting efficiencies in the single-scattering approximation was applied to the study of spectra of monoenergetic neutrons behind water shielding. Monoenergetic 15.1-Mev neutrons originated from the accelerator reaction. Data collected from a target at the center of a water-filled tank (simulating infinite geometry) were compared with theoretical data and with exact Monte Carlo calculation of counting efficiencies. The agreement was good, indicating that the approximation taking into account single hydrogen atom scattering can be utilized for the approximate evaluation of fast neutron spectra. (CFSTI)

31441 DEPTH DISTRIBUTION OF ABSORBED ENERGY FROM NONMONOENERGETIC ELECTRONS. G. B. Radzeivskii and D. P. Osanov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 125-38 (1964). (In Russian)

In the past, a relatively simple calculation of the depth distribution of absorbed energy due to electrons was possible only in two cases: when a thick sample was exposed to an "infinitely wide" beam of monoenergetic electrons and when the electrons originate from a β-emitting isotope. Semiempirical methods for the calculation of electron-generated energy distribution are presented. They are applicable to the estimation of absorbed energy due to electrons with arbitrary energy and different angles of incidence. The comprehensive theory was applied to calculations in flat samples of water-equivalent material in contact with an infinitely thick source (applicator) containing ^{32}P with an isotropic β-flow within the source and for estimation of the energy distribution within a plane sheet of material irradiated from one side by an isotropic flow of electrons from the earth's outer radiation belt (astronaut's approximation). (CFSTI)

31442 SLOWING CAPABILITY OF SOME LOW-ATOMIC-NUMBER MATERIALS FOR 1-4 Mev ALPHA RAYS. G. B. Radzievskii. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 149-58(1964). (In Russian)

In conjunction with the development of a method of α dosimetry experimental determinations were made of the relative (to air) braking capability of some low atomic number materials in the 1 Mev < E_α < 4 Mev region. This work consisted of measuring the air-equivalent of thin layers of various materials as a function of the energy of the incident alpha particles. The equipment, operating at atmospheric pressure, did not yield values for E_α < 1 Mev. A discussion of results obtained by other authors is presented. This method of measurement is compared with the cut-off method. Data are presented for Al, $(C_{14}H_{10})_n$, $(C_5H_4O_2)_n$, $(CH_2)_n$, and $(C_5H_8O_2)_n$. (CFSTI)

31443 BASIC METHODOLOGICAL PROBLEMS IN THE DESIGN OF HIGH-ENERGY PROTON SHIELDING. V. E. Dudkin, E. E. Kovalev, L. N. Smirennyi, and M. A. Sychkov. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 3, 159-67(1964). (In Russian)

Space flights require that the astronauts be protected against the high energy protons found in outer space. For given initial conditions (trajectory, flight duration, etc.), protection requirements (type and thickness of materials,

grouping of protective devices, etc.), which, using a minimum of hardware, will protect the astronaut from radiation doses exceeding the permissible level, must be determined. The first step consists of calculating the radiation levels and total doses on the basis of the known facts about the radiation belts and radiation in general. Next, the pertinent materials that will reduce the doses to the acceptable level with the minimum increase in weight are chosen. Finally, control calculations are carried out to verify the adequacy of the proposed solutions. Each of these steps is discussed and the pertinent theoretical expressions are presented. The calculations showed that the maximum value of the mean tissue dose corresponds to a unit 200 to 250 Mev proton flow. The use of local doses may be justified only in the presence of very energetic protons when the average tissue and local doses become comparable. (CFSTI)

31444 SCATTERING OF 200 kv X RAYS AND ^{60}Co GAMMA RAYS IN WATER AND AIR. I. Eickhoff. Thesis, Muenster, Ger., Universitat, 1964. 45p. (In German). $2.00 (Gmelin, AED-DISS. 64-313)

Scattered radiation doses in water and air were measured. In the vicinity of the field boundary 200-kv x rays resulted in higher doses of scattered radiation than ^{60}Co gamma rays. In water the inverse relation was valid for larger distances than 13.5 cm from the primary beam. (Gmelin Inst.)

Solid State Physics

See also CHEMISTRY — Inorganic and Physical Chemistry
METALS, CERAMICS, AND OTHER MATERIALS — Properties and Structure

31445 (LA-3259) AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAM. V. GENERAL LEAST SQUARES REFINEMENT. Don T. Cromer, R. B. Roof, Jr., and Allen C. Larson (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Sept. 1964. Contract W-7405-eng-36. 111p. Dep.; $4.00(cy), 2(mn) CFSTI.

The procedures employed and the computer program used for determining the positions and thermal motions (isotropic and/or anisotropic) of the atoms in a single crystal are described. The basic technique involves an iterative least-squares procedure. A special feature of this program is the inclusion of a secondary-extinction correction as a least-squares parameter. (auth)

31446 (NP-14947) NUCLEAR QUADRUPOLE RESONANCE AND THE ELECTRONIC STRUCTURE OF GALLIUM. Technical Report No. 7. Sheldon R. Kiser (California Univ., Berkeley. Dept. of Physics). Jan. 1965. Contracts Nonr-3656(05) and Nonr-222(94). 88p.

An investigation of the nuclear quadrupolar coupling in solid gallium metal is carried out with the aid of experiments on a single metallic crystal. Two physically inequivalent sites for the electric field gradient tensor are found, and the orientation of each set of principal axes is determined. A previous measurement of the asymmetry parameter of the electric gradient tensor is described, and an improved value, 0.175 ± 0.010, is reported. The asymmetry parameter may be obtained from the measurement of the splitting of the inner and outer pairs of the Zeeman spectrum when the magnetic field lies in the principal xy plane. The error in the measurements due to neglect of the azimuthal dependence of the splitting in the xy plane is given. A theory of the origin of the field gradient tensor based upon p-type bonding of a gallium atom with its first seven nearest neighbors predicts the quadrupolar coupling constant within 5% of the experimental value. The results suggest that the electronic structure may be described in the tight binding approximation. (auth)

31447 (ORNL-P-1240) METHODS OF ANALYSIS FOR LOCALLY-ORDERED ARRANGEMENTS AND ATOMIC DISPLACEMENTS BY X-RAY DIFFRACTION. C. J. Sparks and B. Borie (Oak Ridge National Lab., Tenn.). Apr. 22, 1965. Contract W-7405-eng-26. 86p. (CONF-650203-8). Dep.(mn); $3.00(cy), 2(mn) CFSTI.

From National American Institute of Mechanical Engineers Meeting, Chicago.

X-ray diffraction techniques are reviewed for application to the determination of the local arrangement of the atoms in solid solutions. The theory is discussed, and later developments are considered. Laboratory procedures for the collection and manipulation of intensity data are given in detail. (D.L.C.)

31448 (RPI-3030-3) NUCLEAR QUADRUPOLE COUPLING STUDIES IN SOLIDS. Annual Report. Philip A. Casabella (Rensselaer Polytechnic Inst., Troy, N. Y.). May 1965. Contract AT(30-1)-3030. 5p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

Results of the study of the ferroelectric phase transition in Rochelle Salt are reported. The effects of a d-c electric field on a rigidly mounted Rochelle Salt crystal indicate that the rigid mounting impedes the motion of domain walls but has no effect on the phase transition. The radiation damage in $NaClO_3$ from ^{60}Co rays was found to be nearly linear (proportional to radiation intensity). Work on the nuclear quadrupole resonance of ^{14}N and on Group III halides is summarized briefly. (D.L.C.)

31449 (SGAE-PH-14/1964) SCHWINGUNGSZUSTAND EINES FREMDATOMS IM KUBISCH FLACHENZENTRIERTEN GITTER. (Vibration State of a Strange Atom in the Cubic Face-Centered Lattice). Ewald Balcar (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). 1964. 11p. Dep.(mn).

The calculation of an isotopic defect was carried out on the basis of a formulation valid for any lattice without explicit knowledge of the frequency spectrum for the special case of a face-centered-cubic crystal. As an example, the defect frequency of palladium with nickel as the defect atom was calculated. (J.S.R.)

31450 (IS-Trans-14) F′-CENTERS IN ALKALI-HALIDE CRYSTALS. P. F. Tomasevich. (Translated by Evelyn E. Conrad (Ames Lab., Ames, Iowa), from Zh. Eksperim. i Teor. Fiz., 11: 1223(1951). 8p. Dep.(mn); $1.00(cy), 1(mn) CFSTI; $1.10(fs), $0.80(mf) JCL.

An evaluation was carried out of the accuracy of the multiplicative approximation of the F′-center theory. Energies of dissociation of an F′ center into an F center and polaron in crystals of NaCl, KCl, and KBr were calculated. These energies agree in order of magnitude with experimental data. (auth)

31451 ELECTRON TUNNEL EFFECT THROUGH VERY THIN INSULATING FILMS. Hi Kyu Kim (Kyoung Hui Univ., Seoul). New Phys. (Korea), 4: 75-8(1964). (In Korean)

Electron tunneling properties of $Al-Al_2O_3-$metal prepared by evaporation method are discussed with the theory of Bethe-Sommerfeld and J. Simmons. Experimental results are interpreted by the theory, and are found to agree in its general trend with the theory. (auth)

31452 ON THE AMPLIFICATION OF TRANSVERSE OPTICAL PHONONS. H. N. Spector (Illinois Inst. of Tech., Chicago). Nuovo Cimento (10), 37: 1731-3(June 16, 1965).

A previous phenomenological treatment (Phys. Rev., 132: 679(1964)) in which it was found that transverse optical phonon modes in semiconductors can be excited only by coupling them to the longitudinal mode is discussed. It is shown that this result arises due to neglect of the effect of the a-c magnetic field, which arises from the lattice vibrations, on the electron current. (C.E.S.)

31453 ON THE STRONG COUPLING TECHNIQUES OF POLARON THEORY. J. T. Devreese and R. P. Evrard (Studiecentrum voor Kernenergie, Mol, Belg. and Universite, Liege). Phys. Status Solidi, 9: 403-10(1965).

The validity of Pekar's polaron theory is investigated by

using it to solve Gross's simplified model in which the electron interacts with only one lattice oscillator. The results are compared with the exact solutions. This shows as expected, that Pekar's approximation provides an accurate strong coupling limit. The accuracy decreases with the mean number of virtual phonons, which is used to define the coupling strength. For a certain value of this parameter. Pekar's method becomes less accurate than the Lee-Low-Pines method. At this point the relative error is about 15%. The present study makes it possible to introduce an intermediate coupling region in Gross's model. In this region the relative error of the Lee-Low-Pines approximation is about 10%. (auth)

31454 ON THE THEORY OF TRANSPORT PHENOMENA WITH ANISOTROPIC SCATTERING. S. Zukotynski and M. Grynberg (Warsaw Univ.). Phys. Status Solidi, 9: 549-53(1965).

A solution of the Boltzmann equation for parabolic and non-parabolic energy bands of the type $\gamma(\epsilon) = a_{\alpha\beta}k_\alpha k_\beta$ is presented. The scattering term in the transport equation is assumed to be of the form $\left(\frac{df}{dt}\right)_{scatt} = -\frac{df_0}{d\epsilon}\Xi(\epsilon)\tau_{ij}^{-1}k_j$. The principal transport tensors are calculated. The case of crystals with low symmetry is given closer consideration and, for example, it is found that for one ellipsoid the longitudinal magnetoresistance vanishes for all magnetic fields. It is shown how the results of papers dealing with first order non-parabolicity and with many-valley problems can be used. (auth)

31455 DISLOCATIONS AS TRAPS FOR HOLES IN GERMANIUM. T. Figielski (Inst. of Physics, Academy of Sciences, Warsaw). Phys. Status Solidi, 9: 555-66 (1965).

A further development of the barrier model of recombination at dislocations is presented. It is shown that in spite of the tunnel effect, the barrier height is the main factor limiting the capture rate of electrons down to about 180°K. Some features of photoconductivity in crystals with dislocations and their temperature-dependences, are discussed (such as the lux-ampere characteristics, and the relaxation of the photocurrent). It is shown how the density of dislocations and the position of the dislocation acceptor level can be estimated from experimental data. (auth)

31456 ELECTRON MICROSCOPY OF DISLOCATIONS AND OTHER DEFECTS IN SAPPHIRE AND IN SILICON CARBIDE, THINNED BY SPUTTERING. C. M. Drum (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Status Solidi, 9: 635-42(1965).

Ion bombardment was employed as a means of thinning crystals of silicon carbide and sapphire for subsequent investigation with transmission electron microscopy. The procedures employed are described. In sapphire, small specks were found, and these were attributed to clustering at room temperature of defects introduced by the bombardment with ~2 kev argon ions used during thinning. Upon heating to 800°C, extensive networks of dislocations were formed, and the motion of these dislocations could be followed. Gas bubbles were present after annealing for an hour at 900°C or above. No dissociation of the dislocations in sapphire was observed, but the Burgers vectors were along the a directions as anticipated. In silicon carbide, wide ribbons of stacking fault were found on the basal planes, and the stacking fault energy was estimated to be 4 erg cm^{-2} within an order of magnitude. (auth)

31457 THE ACTIVATION ENERGY OF SNOEK RELAXATIONS IN Bcc METALS. E. T. Stephenson (Bethlehem Steel Co., Penna.). Trans. Met. Soc. AIME, 233: 1183-4 (June 1965).

Recently published data of the activation energy and peak temperature of interstitial diffusion in several bcc metals were used to calculate the activation energy of a Snoek relaxation as a function of the temperature at which the peak relaxation occurs. A straight line relaxation between the activation energy and peak temperature was found. This supports the theory of interstitial diffusion coefficients and implies that D_0/a_0^2 is a constant for interstitial diffusion in bcc metals. (W.L.G.)

REACTOR TECHNOLOGY

General

Refer also to abstract 31184.

31458 (ANL-6781) ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF A NUCLEAR REACTOR SUPPORT STRUCTURE. A. H. Marchertas, S. H. Fistedis, and R. O. Brittan (Argonne National Lab., Ill.). Mar. 1965. Contract W-31-109-eng-38. 98p. Dep.; $4.00(cy), 2(mn) CFSTI.

A general procedure is presented for determining the deformation (slopes and deflections) of a grid support structure for a nuclear reactor. Use is made of the Rayleigh-Ritz perturbation method which involves an infinite series of polynomials. The grid structure consists of two circular perforated plates separated and interconnected by a large number of tubes. The holes are distributed in a hexagonal pattern with respect to the center of the plates. Tubes pass through each hole and serve as supports for loads acting on the top end of every tube. The edges of the plates are peripherally supported and may have any degree of restraint ranging from fixed to simple supports. The complexity introduced by the holes in the plates is circumvented by the use of an equivalent solid plate. This idea, developed and substantiated by a number of investigators, is also applied to approximate pertinent stresses in the perforated plates. A model was constructed to yield some experimental data. Although the model was a simplification of what could be expected in practice, nonetheless it brought forth some interesting and unexpected results. The analytical predictions, provided by IBM-704 Fortran II computer program, were compared with the experimental results. The results were discussed and appropriate conclusions were drawn. (auth)

31459 (ANL-7010) REACTOR PHYSICS DIVISION ANNUAL REPORT, JULY 1, 1963–JUNE 30, 1964. (Argonne National Lab., Ill.). Jan. 1965. Contract W-31-109-eng-38. 295p. Dep.; $7.00(cy), 5(mn) CFSTI.

Research and development are summarized in sections on fission properties and cross section data, thermal reactors, fast reactors, experimental techniques and facilities, and miscellaneous reactor theory problems. Separate abstracts were prepared for each section. (J.R.D.)

For abstracts of individual sections see: 31215, 31460, 31461, 31495, and 31530.

31460 (ANL-7010(p.179-233)) EXPERIMENTAL TECHNIQUES AND FACILITIES. (Argonne National Lab., Ill.).

Development of special techniques, facilities, and radiation detection devices for measuring integral reactor physics parameters are discussed. Methods for the analysis and interpretation of experimentally determined quantities are also discussed along with the development of special equipment for the detection of reactor fuel element failures. (J.R.D.)

31461 (ANL-7010(p.235-87) MISCELLANEOUS. (Argonne National Lab., Ill.).

Efforts to extend and improve the accuracy of general reactor physics theory are reported. Papers on exploratory work necessary to evaluate the extent of applications of reactor technology and to define in more exact fashion the problems that exist are included. Papers are also included on applications in outer space, meteorology, and research tools. Computing work in reactor physics is described in papers on numerical analysis, work applicable to physics problems, and code development for specific problems. Compilation of basic data for use in analysis is described. Development of computing techniques for the solution of elasticity problems in cylindrical coordinates is discussed. Descriptions of component developments which grew out of the needs of programmatic work, and are applicable to a wide range of experimental activities are included. (J.R.D.)

31462 (ANL-7028) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1965. (Argonne National Lab., Ill.). Apr. 20, 1965. Contract W-31-109-eng-38. 93p. Dep.; $3.00(cy), 2(mn) CFSTI.

Research and development are reported on EBR-II, FARET, ZPR-III, ZPR-VI, ZPR-IX, and ZPPR. Research on fast reactor fuels, fuel processing, reactor physics, and theoretical physics is described along with development work on high-temperature materials, reactor engineering, chemical separations, and Pu recycle reactors. Research and development are also reported on Argonne Advanced Research Reactor and magnetohydrodynamics. Nuclear safety studies are summarized. (J.R.D.)

31463 (CRCE-1189) IMPURITY EFFECTS IN THE FOULING OF HEAT TRANSFER SURFACES BY ORGANIC COOLANTS. A. R. Bancroft, D. H. Charlesworth, and J. H. Duerksen (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1965. 62p. (AECL-1913). Dep.; $1.50(AECL).

Previous work showed that fouling in organic-cooled systems resulted from impurities in the terphenyl-based coolant. Tests in small loops of the effect on fouling of various impurities are reported, which give further insight into the fouling mechanisms and show that chlorine is by far the strongest promoter of fouling. Small effects of radiolytic products, water, and oxygen were observed. In a 1000-hr out-reactor test the rate of increase in thermal resistance at the heater surface was related to deposition rate. On the basis of this test a deposition rate of 0.2 $\mu g/cm^2$-hr will cause an increase of 25°C/year in the sheath temperature of fuel elements having a heat flux of 100 w/cm^2. In-reactor loop tests demonstrated that by continuous coolant purification and exclusion of impurities such as chlorine, fouling under power reactor conditions can be restricted to acceptable rates. (auth)

31464 (IDO-17042) NUCLEAR TECHNOLOGY BRANCHES QUARTERLY REPORT, APRIL–JUNE 30, 1964. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Nov. 1964. Contract AT(10-1)-205. 80p. Dep.; $3.00(cy), 2(mn) CFSTI.

Four sections are included; a separate abstract has been prepared for each. (T.F.H.)

For abstracts of individual sections see: 30483, 30641, 31217, and 31465.

31465 (IDO-17042(p.1-10)) REACTOR ENGINEERING. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.).

Investigations are reported of: the performance and feasibility of B_4C–Al duplex cladding on ETR-MTR fuel plates; radiation effects on these plates; mechanical properties of ATR fuel elements under hydraulic stresses; and the achievement of criticality in the ATR Critical Facility. (T.F.H.)

31466 (KAPL-3093) REACTIVITY STABILITY OF A BOILING REACTOR. PART 2. A. B. Jones (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 1, 1965. Contract W-31-109-eng-52. 40p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The linearized, density-dependent reactivity stability of a one-flux-mode boiling reactor is considered. Transient flow redistribution is permitted at the channel inlets, in accordance with momentum equation considerations in each channel, with the imposed constraint that the total reactor inlet flow is constant. A digital computer program (FABLE) that mechanizes the analysis is described. (auth)

31467 (LA-DC-7007) RECENT DEVELOPMENTS IN COMPUTERS AND THEIR IMPLICATIONS FOR REACTOR

CALCULATIONS. W. J. Worlton and E. A. Voorhees (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract [W-7405-eng-36]. 30p. (CONF-650501-7). Dep.(mn); $2.00(cy), 1(mn) CFSTI.

From the Application of Computing Methods to Reactor Problems, Argonne, Ill.

The capabilities and economics of ultrahigh-speed computers for reactor calculations are analyzed. The requirements imposed on the computer industry by reactor calculations are reviewed. The basic types of calculations involved include: criticality, transport, diffusion, dynamics, kinetics, burnup, physics, cross sections, reactor parameters, shielding, engineering, heat flow, stress analysis, and coolant flow. (T.F.H.)

31468 (ORNL-3789(p.263-70)) BEHAVIOR OF FISSION PRODUCTS RELEASED DURING IN-PILE SIMULATED LOSS-OF-COOLANT ACCIDENTS. W. E. Browning, Jr., C. E. Miller, Jr., R. P. Shields, B. F. Roberts, J. G. Wilhelm, W. H. Montgomery, and O. W. Thomas (Oak Ridge National Lab., Tenn.).

In-pile experiments are being continued to study the characteristics and behavior of fission products released by melting or vaporizing miniature stainless-steel-clad UO_2 fuel elements in the ORR in a variety of atmospheres. The most significant variation in the behavior of fission products as a function of atmosphere is the high release of Ru and I in moist air from a zone whose minimum temperature is 1000°C. In experiments in which steam was a component of the sweep gas, substantial quantities of fission products were trapped by the condensate and collected in the condenser. Interpretation of the I data from in-pile UO_2 melting experiments leads to the conclusions that: (1) a major fraction of released I stops on metal surfaces, although this deposition is inhibited by moisture in the atmosphere, (2) particulate filters effectively stop I released in all atmospheres investigated except moist air, and (3) only 0.0001% of the I found in each of these experiments penetrated the filter system, in-pile charcoal trap, and outlet tubing. A facility designed and built in the ORR to provide high-burnup fuel for the in-pile UO_2 melting experiments is being used to irradiate UO_2 capsules to approximately 21,000 Mwd/ton. Additional equipment required to perform hot-cell assembly of the experimental apparatus was installed and satisfactorily tested. (J.R.D.)

31469 (TIM-829) STERNO—A TWO-DIMENSIONAL, GAMMA-HEATING CODE. C. E. Keller (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Aircraft Nuclear Engine Lab.). Oct. 14, 1964. Contract AT(11-1)-229. 62p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

STERNO is a two dimensional (r-z), gamma-heating code written in FORTRAN 63 for the CDC 1604 digital computer. The code has been programmed to accept microscopic photon-production cross sections, material number densities, and TDC binary-punched neutron fluxes for the calculation of photon sources prior to the heating calculation. The heating calculation is performed by a substantially modified version of 2DGH code. (auth)

31470 REACTION OF THE LIQUID AND REACTOR CONTROL AND SAFETY RODS. R. R. Ionaitis. At. Energ. (USSR), 18: 422-6(Apr. 1965). (In Russian)

Simple formulas were developed for calculating the hydrodynamic forces affecting the loading and unloading control and safety rods in the active zone channel, the loss of liquid during rod extraction from the active zone, the rate of loading. The ratio of the relative rate of rod motion to the relative liquid motion in the channel was plotted. The formulas were used for calculating the rate of rod loading in a static liquid and in a counter flow or in lifting as a function of the liquid displacement during the operation. (R.V.J.)

31471 ORGANIC COOLANT SYSTEM AND THE APPLICATION TO THE RESEARCH OF ENGINEERING AND REACTOR PHYSICS. Yoshio Tsuji and Takeo Matsubara (Sumitomo Electric Ind. Ltd., Japan). Sumitomo Denki, No. 87, 117-22(Jan. 1965). (In Japanese)

Using an organic coolant (terphenyl), an experimental installation for reactor physics and engineering at high temperatures (up to 400°C) was developed. This installation is being used not only for the development of organic-cooled reactors but for research in many other fields. (NSA of Japan)

31472 URANIUM RESOURCES AND REACTOR DEVELOPMENT. Marten Martensson (Aktiebolaget Atomenergi, Stockholm). Tek Tidskr., 94: 517-24(May 1964). (In Swedish)

The question of how soon breeder reactors should be put into operation in order to utilize completely the possibilities offered by the limited U and Th resources of the world is discussed. Conditions in Sweden are compared with those in the United States. (M.C.G.)

31473 DEVICE FOR PREPARATION OF AN ELECTRIC CONNECTION ALONG A CHANNEL OF A NUCLEAR REACTOR. Jean Liermann (to Commissariat a l'Energie Atomique). German Patent 1,188,739. Mar. 11, 1965. Priority date Dec. 18, 1962, France.

Electrical contact between neighboring fuel element cans is established by electrically conducting rods sliding in longitudinal channels provided in the cans. The rods have the same length as the fuel elements and are axially displaced relative to the fuel elements so that one end of each rod extends beyond the corresponding end of the fuel element (plug-contact) and the other end is drawn into the can (bush). The fuel elements are stacked up in such a way that the protruding end of the rod of one fuel element is inserted into the empty end portion of the channel of another neighboring fuel element. (Gmelin Inst.)

Auxiliaries and Components

Refer also to abstracts 31217, 31540, 31576, and 31580.

31474 (BAW-1280-23) SODIUM-HEATED STEAM GENERATOR DEVELOPMENT. Progress Report No. 21, January 1965. (Babcock and Wilcox Co., Barberton, Ohio. Boiler Div.). Contract AT(11-1)-1280. 57p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Background information on work phases is presented, and the status of each phase is summarized. The preliminary design of a full-sized steam generator is complete. The preliminary design of a prototype steam generator is approximately 75% complete. The analysis of Na–water reaction problems in full-size and prototype steam generators is reported. A project on a flow model of Na distributor is described. (J.R.D.)

31475 (BAW-1280-24) SODIUM-HEATED STEAM GENERATOR DEVELOPMENT. Progress Report No. 22, February 1965. (Babcock and Wilcox Co., Barberton, Ohio. Boiler Div.). Contract AT(11-1)-1280. 71p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Background information on work phases is presented, and the status of each phase is summarized. The preliminary design of a full-sized steam generator is complete. The preliminary design of a prototype steam generator is approximately 80% complete. The analysis of Na–water reactions in full-sized and prototype steam generators is reported. Competitive bids are being solicited on long-lead materials for the prototype steam generator. (J.R.D.)

31476 (BNWL-26) INSTRUMENTATION DEVELOPMENT FOR THE CONTAINMENT SYSTEMS EXPERIMENT. C. E. Huck (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 3, 1965. Contract AT-(45-1)-1850. 12p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The instrument development program and the detailed instrumentation requirements for the Containment Systems Experiment (CSE) are described. The CSE will include a number of test runs in which several nuclear reactor containment concepts will be evaluated during simulated reactor coolant line ruptures. Estimated costs of instrument components, electronic equipment, prototype transducers, and strain gages are presented. (L.B.S.)

31477 (EGG-1183-1130) OPERATIONAL AMPLIFLIERS FOR MAXIMUM FLEXIBILITY IN REACTOR CONTROLS. Ezra Budge (Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.). Apr. 13, 1965. Contract AT(29-1)-1183. 23p. (CONF-650412-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From IEEE Convention, Las Vegas, Nev.

The capabilities of operational amplifiers for use in the development of test-stand reactor control systems and associated circuitry are detailed. Examples are drawn from control systems developed for Rover Project reactors. (T.F.H.)

31478 (ORNL-3789(p.251-62)) EXPERIMENTS WITH THE CONTAINMENT MOCKUP FACILITY. G. W. Parker, C. J. Barton, G. E. Creek, J. G. Wilhelm, and W. J. Martin (Oak Ridge National Lab., Tenn.).

The Containment Mockup Facility (CMF) consists primarily of a 6.7-ft^3 stainless steel tank in which fission product aerosols released from irradiated fuel specimens by induction heating can be aged and sampled to study the transport behavior of the fission products. Two experiments were performed in the CMF with stainless-steel-clad UO_2 fuel specimens irradiated to a trace level. The specimens were melted in a flowing air stream, and the fission product aerosol was transferred to the tank and allowed to age for approximately 3 hr. It was found that ten times as much I penetrated a 1.5-in.-thick charcoal bed when part of the air in the tank was unfiltered, as compared with the penetration observed when only filtered air was present in the aging tank. Approximately equal amounts of particulate and molecular I were present at the end of the aging period. The I, Cs, and Te concentrations in the tank aerosol dropped rapidly in the first 10 min of the aging period; about 75% of the I on the tank wall desorbed during passage of 1.5 tank volumes of Ar through the tank after the 3-hr aging period. The number of airborne particles decreased by a factor of 10^3; but the amount of filterable activity did not change significantly, indicating that the particles were too small to deposit rapidly. I produced in simulated reactor accidents can be separated into three fractions: particulate I (iodides, or I adsorbed on particles), reactive I (principally molecular iodine or HI), and nonreactive I (organic compounds are the principal constituents identified to date). In nuclear safety experiments, fuel pellets were fabricated containing the concentration of I, Te, Ru, Cs, Sr, and Mo corresponding to a burnup of 10,000 Mwd/ton. The pellets were clad in stainless steel and were melted in the CMF; the behavior of the resulting aerosol, after aging for 3.5 hr, was compared with that of one released from an actual fuel element melted under similar (but not identical) conditions. I, Cs, Sr, and Ru showed comparable release values, but differences were found in the release values of Te. A new facility, designed for hot-cell installation, will have features such as a fission product aerosol generator for heating 100-g quantities of high-burnup fuel to the melting point of UO_2 and at intermediate temperatures, a primary vessel simulator that can be heated to 800°C, a 1000-gal pressurized containment shell that can be supplied with different interior surfaces, a recycle filter test facility, and provision for simulation of top or bottom breaks in the primary vessel. The melting points of UO_2-cladding mixtures were investigated. Melting points increased with increased weight of UO_2 in the mixture. Oxidized stainless steel–UO_2 mixtures melted at 1500 to 1650°C. A ZrO_2–Zr–UO_2 mixture prepared by melting a Zircaloy-clad UO_2 fuel specimen in air melted at 2150°C. (J.R.D.)

31479 (WASH-1054(Pt.I)) PROCEEDINGS OF THE MEETING ON FAST REACTOR CONTROL MECHANISMS HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, SEPTEMBER 16 AND 17, 1964. C. J. Heltemes, Jr., ed. (Division of Reactor Development (AEC), Washington, D. C.). [nd]. 200p. (CONF-756). Dep.; $5.00(cy), 4(mn) CFSTI.

Seven papers are included; separate abstracts have been prepared for 6. The remaining paper was previously abstracted in NSA, 19: 1881. (T.F.H.)

For abstracts of individual papers see: 31480, 31557, 31558, 31559, 31612, and 31613.

31480 (WASH-1054(Pt.I)(p.1-14)) REVIEW OF FAST REACTOR CONTROL FUNDAMENTALS. R. R. Smith (Argonne National Lab., Idaho Falls, Idaho).

A sketch is presented of the evolution and status of fast reactor control concepts. (T.F.H.)

31481 ANTISEISMIC DESIGN OF REACTOR VESSEL. Iosikatu Tuboi and Sigennari Kavanata. Genshiryoku Hatsuden, 7: No. 1, 35-42(1963). (In Japanese)

A method is presented for calculating the characteristic period of transverse vibration and for analyzing the stress and displacement at a given acceleration specified in an antiseismic project for the spherical steel vessel of a light-water reactor. Formulas are derived for orientation calculations according to the theory of nonsymmetrical stress on a spherical vessel. Formulas are also given for calculating the period of natural transverse vibration when the lower part of the spherical vessel is either fixed or free. The characteristic vibration period of a 60-m-diameter spherical vessel was found to be 0.2 sec for either condition. (D.C.W.)

31482 THREE-DIMENSIONAL PHOTOELASTIC STUDY OF STRESS AROUND NOZZLES IN PRESSURE VESSELS. Tsutomu Iwasaki and Hisashi Ouchida (Hitachi, Ltd., Tokyo). Hitachi Hyoron, Spec. Issue, 102-6(Nov. 1964). (In Japanese)

The stress distribution around a discontinuous part, e.g., at the nozzle, of a reactor pressure vessel was studied by means of photoelasticity. Cylindrical and spherical vessel models with various nozzles were prepared for the tests. These vessel models were obtained by molding epoxide resin; they were annealed at 130°C for 24 hr, then cooled at 5 to 8°C per hour. Pressure was applied to the model structures and the stresses produced were frozen by a heat-treatment method. Then the test specimens were cut off for the photoelastic tests. The stresses for the rectangular flush nozzle on a spherical vessel agreed well with the theoretical value; the stresses of the oblique one were about 60% larger than the rectangular. Smaller concentrations of stress were observed for the nozzles penetrating through the vessel wall than the flush nozzles. (NSA of Japan)

31483 IMPROVEMENTS IN OR RELATING TO PRESSURE VESSELS. Herbert Chilvers Knights (to United Kingdom Atomic Energy Authority). British Patent 980,396. Jan. 13, 1965. Filed Jan. 4, 1963.

A pressure vessel enclosing a nuclear reactor includes at least two skins of stress-accepting plates. Each of the two adjacent skins are separated from each other by a stress-accepting framework to which each skin is fixed. This form of construction is applicable to on-site construction and reduces the thickness of plate required to give the vessel working pressure. (B.L.M.)

31484 IMPROVED ARTICLE HANDLING DEVICE. (to General Dynamics Corp.). British Patent 982,749. Feb. 10, 1965. Priority date Oct. 10, 1962, United States.

A device is described for handling articles, particularly fuel elements in a reactor. The device comprises a vertical elongated tubular housing with a pair of guide members disposed within it and secured to the housing to define the spaced region between the members and the housing. An arcuate path is defined by arcuately shaped guideways provided in the guide members. The guideways are arcuately shaped cam tracks. An arcuate arm is mounted between the guide members and has projecting portions, cam members, positioned for movement on the cam tracks substantially along the longitudinal axis of the housing. The movement imparting means is secured to the upper end of the arm. The advance of the arm as dictated by the movement of the projecting portions through the arcuately shaped guideways is translated into move-

ment of the lower end of the arm along a path substantially perpendicular to the longitudinal axis of the housing. The device is adapted to effect manipulation of components confined in a vessel such as a reactor vessel that has at least one entry port and the device is mounted within the port for movement into and out of the vessel. In this same application, a grappling means may be secured to the lower end of the arm for engaging components. (B.L.M.)

31485 SAFETY DEVICE FOR NUCLEAR POWER REACTORS. (to Beteilgungs- und Patentverwaltungs-Mit Beschrankter Haftung). British Patent 983,216. Feb. 10, 1965. Priority date Apr. 28, 1961, Germany.

A restricting device is described for use in a pipe line between a supply tank for gas such as might be used for cooling purposes and a reaction chamber in a reactor to prevent radioactive contamination of the gas in the supply tank. The restrictor is so designed that gas can pass freely through when pressure in the supply tank is sufficiently higher than that in the reaction chamber. However, when the pressure in the supply tank is less than that in the reaction chamber, the rate of return flow of radioactively contaminated gas is reduced so that its radioactivity decays to a sufficient extent during passage through the restrictor. The restrictor is made up of a plurality of closeable shut-off valves connected in series. (B.L.M.)

31486 IMPROVEMENTS IN OR RELATING TO CONCRETE PRESSURE VESSELS. Cecil Massey (to United Kingdom Atomic Energy Authority). British Patent 983,379. Feb. 17, 1965. Filed Feb. 12, 1963.

A method is described for constructing a portion of a prestressed concrete pressure vessel in which the portion is penetrated by access apertures arranged in a lattice array. The method includes laying a lift of concrete including a group of stacks of spaced cables between adjacent rows of apertures followed by another lift of concrete including another group of stacks of spaced cables. The stacks of the second life are displaced relative to the stacks of the former lift. (B.L.M.)

31487 IMPROVEMENTS RELATING TO NUCLEAR REACTOR INSTALLATIONS. Allan Barker (to United Kingdom Atomic Energy Authority). British Patent 983,535. Feb. 17, 1965. Filed Feb. 11, 1963.

A nuclear reactor installation provides in a heat exchanger utilizing heat derived from the reactor that the flow of fluid to be heated in it can be maintained whenever the removal of heat from the core is necessary, e.g., to prevent overheating of the core due to radioactive decay of fission products after the reactor is shut down. A main feed pump and a supplementary feed pump of the injection type are provided for feeding the fluid to be heated to the heat exchanger. A conduit supplies to the injector of the supplementary feed pump a minor portion of the heated fluid output from the heat exchanger. This conduit is open permanently so that the injector is continuously operative. (B.L.M.)

31488 NUCLEAR REACTOR CONTROL MECHANISM. David John Ashcroft (to United Kingdom Atomic Energy Authority). British Patent 983,595. Feb. 17, 1965. Filed Aug. 30, 1962.

A nuclear reactor control mechanism is described in which a reactivity control element is driven by a fluid-operated piston and cylinder device. The control element is constituted by the cylinder that is movable, while the piston is fixed. The control element is loaded by a spring acting between the control element and a member supporting the piston rod carrying the piston. The control mechanism is particularly applicable to a reactor having the core cooled by a circulating coolant, and the control mechanism is so connected to the coolant circuit that the pressure difference between the interior and the exterior of the control element is equal to the coolant pressure differential across the core. The control mechanism extends into a plenum to be filled with coolant leaving the core so that the cylindrical control element is subject externally to the core outlet pressure and is connected for internal pressurization by coolant at the core inlet pressure. (B.L.M.)

31489 NUCLEAR REACTOR. David John Ashcroft (to United Kingdom Atomic Energy Authority). British Patent 983,596. Feb. 17, 1965. Filed Aug. 30, 1962.

A liquid-moderated reactor includes a hollow neutron-absorbing control element that displaces the liquid moderator in moving with an open end foremost into the core. A filler element composed of a rod of graphite clad in a metallic sheath is so positioned in the moderator that it is surrounded by the control element when the control element is located within the core. The control element includes a hollow cylinder slidable on a fixed piston while the filler element is supported by the piston. (B.L.M.)

31490 IMPROVEMENTS IN NUCLEAR REACTORS. (to Societe Anglo-Belge Vulcain). British Patent 983,881. Feb. 17, 1965. Priority date May 24, 1961, Belgium.

A method for controlling the reactivity of a reactor having a core including the moderator consists of using a variable composition obtained by mixing two fluids having different moderating characteristics by injecting and extracting poisons in the moderator. After the reactor has been shut down by poisoning, it may be brought up to power again by rinsing out the poisoned moderator and replacing it with fresh moderator. (B.L.M.)

31491 PRESTRESSED CONCRETE PRESSURE VESSEL. Bellier, Jean (to Commissariat a l'Energie Atomique). Canadian Patent 708,357. Apr. 27, 1965. Priority date May 8, 1963, France.

A prestressed concrete pressure vessel for gas cooled reactors is described. A gas-tight steel membrane serves as a lining for a chamber which is delimited by the pressure vessel, a cylindrical shell consisting of an outer active concrete zone traversed by prestressing cables and an inner passive concrete zone. It is claimed that the proposed design overcomes disadvantages of gas or water secondary cooling circuits, such as, heat and power losses, elaborate equipment, and the need for internal walls which can withstand pressure differentials. Special design features allow for thermal and expansion stresses. (F.S.A.)

31492 ROD DRIVE SYSTEM FOR USE WITH NEGATIVE TEMPERATURE COEFFICIENT REACTOR. Harold A. Thomas and Charles E. Clifford (to General Dynamics Corp.). U. S. Patent 3,162,579. Dec. 22, 1964. Filed Aug. 9, 1960.

A rod control system with means for rapidly and automatically starting up or raising the power of the reactor to a predetermined level is described for particular application to reactors that exhibit a large, prompt negative temperature coefficient. The control system is inexpensive to manufacture, is durable in operation, and is suitable for controlling the reactor in both the steady state and in transient operations. The system includes a control rod movable vertically relative to the reactor core to vary the neutron losses in the core. The rod is connected to a piston that is movably disposed within a vertically extending cylinder that is supported above the reactor core. The piston is moved relative to the cylinder by fluid pressure applied to the lower end of the cylinder. The cylinder itself is moved relative to the support means above the core by a drive means. A plurality of control rods may be similarly controlled. (B.L.M.)

31493 METHOD FOR PRESSURE RELIEF IN GAS CONTAINERS AND MEANS FOR CARRYING OUT THE METHOD. Bjoern Widell (to Allmanna Svenska Elektriska Aktiebolaget). U. S. Patent 3,166,479. Jan. 19, 1965. Priority date May 26, 1961, Sweden.

A method for relieving the pressure of a gas container containing a mass of gas under pressure is described for particular use for pressure relief carried out from a container containing radioactive gases from a homogeneous reactor. The gas container is connected successively to a plurality of gas collecting vessels while

the container is maintained out of connection with any other vessel until the collector that is connected reaches substantial equilibrium with the pressure of the gas in the container. The last collecting vessel with which the gas container is connected is evacuated to sub-atmospheric pressure before the connection is made. (B.L.M.)

31494 DEVICE FOR ALIGNING FUEL CARTRIDGES IN A CHANNEL OF A NUCLEAR REACTOR. Jean Liermann (to Commissariat a l'Energie Atomique). U. S. Patent 3,167,483. Jan. 26, 1965. Priority date Apr. 6, 1962, France.

A device is described that affects with the necessary precision the centering and alignment of cartridges in relation to one another as they are introduced into the reactor channel without the use of guide means disposed between the set of cartridges and the wall of the channel, without increasing the length of the cartridges, and without adding any appreciable complication to their structure. The aligning device includes a male and a female portion, each secured to one of the terminal plugs on each cartridge. Either the male or female portion consists of an annular ring surrounding the bearing face of the plug and having a semi-toroidal outer surface, and the other portion consists of an annular ring surrounding the bearing surface of the other plug and having a frustro-conical external structure. The centering members only ensure the alignment of the cartridges when they are being positioned, and the plugs are provided for the purpose of force transmission for which they are designed. (B.L.M.)

Criticality Studies

See also PHYSICS — Criticality Studies.

Refer also to abstracts 31459 and 31530.

31495 (ANL-7010(p.21-76)) THERMAL REACTORS. (Argonne National Lab., Ill.).

Work is reported ranging from general reactor theory motivated by analysis of thermal reactors to detailed design problems associated with specific programs such as plutonium recycle in EBWR and the Argonne Advanced Research Reactor. Studies applicable to a wide range of existing designs of thermal reactors, such as boiling water reactor kinetics, are included. In the area of fuel conservation in burner reactors, studies were conducted on the use of depleted U as a fertile control material and on the analysis of water lattices with high conversion ratios (the Hi-C lattices). Experiments on the U-D_2O systems with flux traps are reported; these include the lattices with predicted $k_\infty < 1$. These lattices were made critical by moderation of neutrons to energies below the resonance capture range while in the reflector regions. (J.R.D.)

31496 (AP-Note-399) CONTROL ROD PROGRAMMING. PART II. TWO-GROUP THEORY OF GENERAL CONFIGURATION. R. L. Murray (Alco Products, Inc., Schenectady, N. Y. Nuclear Power Engineering Dept.). June 20, 1962. Contract AT(30-1)-2639. 30p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

An investigation of the possibilities of buckling calculations for partly inserted control rods, made on the one-group neutron diffusion model, indicated that extension to the two-group model was possible. A method is given for determining buckling (and hence reactivity) of a general array of partly inserted control rods in a cylindrical bare equivalent reactor. At this stage of development of the theory, fuel burnup is not specifically included; criticality is provided implicitly by variation of the effective number of neutrons per fission. The buckling is found to be calculable from suitable flux averages over the various regions of the operating core. (auth)

31497 (AP-Note-441) PRELIMINARY INVESTIGATION OF DEPENDENCE OF TEMPERATURE COEFFICIENT OF REACTIVITY ON REACTOR CONFIGURATION. R. L. Murray (Alco Products, Inc., Schenectady, N. Y. Nuclear Power Engineering Dept.). June 20, 1962. Contract AT(30-1)-2639. 14p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The dependence of temperature coefficient of reactivity on size and shape of a heavily loaded reactor is investigated by the simplest theoretical model that could incorporate dominant effects. In a reactor with very large thermal neutron absorption, fast leakage is much more important than thermal leakage, which suggests that a modified-one-fast-group diffusion theory could be reasonably applied. The one-group diffusion-theory model, the development of a perturbation theory that encompasses both absorption and leakage effects, and the formulation of expressions for temperature coefficients as they depend on core configuration are included. (auth)

31498 (AP-Note-443) COMPARISON OF UNIFORM AND NON-UNIFORM DEPLETION IN REACTOR CORES WITH BURNABLE POISON. Raymond L. Murray (Alco Products, Inc., Schenectady, N. Y. Nuclear Power Engineering Dept.). July 5, 1962. Contract AT(30-1)-2639. 24p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The consumption of fuel in a reactor with flux that is other than completely uniform tends to result in an accelerated loss of reactivity. The regions of high flux (and hence high consumption) are also the regions of large importance from the reactivity standpoint. Burnup varies as the flux, reactivity varies as the square of the flux. The presence of a burnable poison such as ^{10}B tends to counteract this effect, in that the excessive removal of controlling poison in the high flux zones gives a higher rate of positive reactivity injection. The fact that the cross section for poison differs from that of the fuel gives a different rate of depletion during reactor life, implying a variation in time of the competing reactivity effects. An estimate of the degree of the compensation of non-uniform burnup of fuel by non-uniform poison usage is made, with comparisons to an idealized situation in which the flux is entirely uniform at all times through core life. (auth)

31499 (BNWL-3) A MONTE CARLO STUDY OF HOMOGENEOUS PLUTONIUM AND URANIUM MIXTURES. L. L. Carter and C. R. Richey (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1964. Contract AT(45-1)-1350. 51p. Dep.; $3.00(cy), 1(mn) CFSTI.

Monte Carlo methods were used to calculate the infinite multiplication factor and other parameters of interest for a variety of mixtures of plutonium and uranium. These calculations were performed with the HISMC Monte Carlo computer code, which samples neutron lifetimes from birth to absorption for infinite, homogeneous systems. Inelastic scattering events were assumed to be isotropic in the center of mass system with the energy loss determined from either stored transfer matrices or the statistical model. Anisotropic elastic scattering for neutron energies in excess of 0.1 Mev was also included. The second and fourth moments of the slowing down distributions were obtained from a space-independent technique. (auth)

31500 (CONF-654-56) THE INFLUENCE OF SYSTEM PARAMETERS ON THE DYNAMIC RESPONSE OF A D_2O-MODERATED REACTOR. R. L. Johnson and J. A. Norberg (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). [nd]. Contract AT(10-1)-205. 9p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Nuclear Society Meeting, San Francisco, Nov.-Dec. 1964.

Power excursion tests of D_2O-moderated and -cooled reactors, under conditions of forced coolant flow or no forced flow, are described. The tests are carried out in SPERT-II. (T.F.H.)

31501 (GAMD-5411) GASP — A COMPUTER CODE FOR BURNUP INDEPENDENT POWER SHAPING BY FUEL ZONING. K. R. Van Howe (General Atomic, San Diego). Dec. 7, 1964. Contract AT(04-3)-167. 154p. Dep.(mn); $5.00(cy), 5(mn) CFSTI.

The input forms and Fortran listings for GASP code, which is used to study burnup-independent power shaping in reactors by means of fuel zoning, are presented. A sample problem is worked out. (T.F.H.)

31502 (INR-470/IX-A) NEUTRON DENSITY AND FLUX DISTRIBUTIONS IN THE ANNA CRITICAL ASSEMBLY. Jacek Arkuszewski, Cyryl Dabrowski, Edward T. Jozefowicz, Krystyna Jozefowicz, Wlodzimierz Kaczmarek, Stefan Malewski, and Andrzej Szechter (Institute of Nuclear Research, Warsaw (Poland)). Nov. 1963. 27p. Dep.

First measurements of the space-energy distributions of the neutron flux in the ANNA Critical Assembly were carried out. The r-spectral index spatial distribution was determined. By fitting the experimental data to the theoretical distribution the B_z component of the buckling was determined. Preliminary estimation of the disadvantage factor and its distribution along the z-axis was performed. Micro- and macroscopic criticality parameters of the assembly for the lattice investigated were calculated. (auth)

31503 (INR-572/IX-A) RESULTS OF THE DETERMINATION OF THE TWO-GROUP SPECTRUM PARAMETERS IN THE CELL OF THE ANNA REACTOR. S. Malewski and A. Szechter (Institute of Nuclear Research, Warsaw (Poland)). Nov. 1964. 19p. Dep.

An attempt was made to evaluate the two-group neutron spectrum parameters in the cell of the zero power reactor ANNA. Activation measurements were performed using gold, lutetium, and copper foils. The intracell distribution of the spectral index r and reaction rates of ^{176}Lu, ^{63}Cu, and ^{197}Au were measured. (auth)

31504 (LA-3221) REACTOR MINIMUM CRITICAL DIMENSIONS. Carroll B. Mills (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Oct. 1959. Contract W-7405-eng-36. 52p. Dep.; $3.00(cy), 2(mn) CFSTI.

The parametric study of minimum critical reactor dimension as a function of moderator, fissionable isotope, and size has been made, based on a consistent variety of critical experiments. Minimum critical size and mass have been computed for a range of concentration of ^{233}U, ^{235}U, and ^{239}Pu for H_2O-moderated bare and reflected slab, cylinder, and sphere geometries, as well as corresponding results for ^{235}U and heavier atom moderators D_2O, Be, BeO, and C. Some results are presented of the same sort for D_2O, Be, and C reflector-moderated reactors. (auth)

31505 (LA-DC-5663) DPC—A TWO-DIMENSIONAL DATA PREPARATION CODE. B. M. Carmichael and W. H. Hannum (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 12p. (CONF-650501-8). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From the Application of Computing Methods to Reactor Problems, Argonne, Ill.

The FORTRAN code, DPC, was developed primarily for preparing (r,z) input data for the two-dimensional codes DDK and CRAM. Techniques developed through application of the code to different reactor designs are illustrated. Descriptions are given of input and specifications for various subregion dimensions and shapes, output, error checks, machine requirements, and applications. (M.J.T.)

31506 (TID-21860(Summ.)) MEASUREMENT OF REACTOR SHUTDOWN MARGIN BY CORRELATION TECHNIQUES. Summary Report. Robert E. Uhrig (Florida Univ., Gainesville. Dept. of Nuclear Engineering). May 1965. Contract AT(40-1)-3067. 83p. Dep.(mn); $3.00 (cy), 2(mn) CFSTI.

The measurement of the impulse response function of nuclear systems by pseudo-random source excitation obtained by modulating the output of a neutron generator in a pseudo-random "on-off" manner is discussed. The instrumentation allows use of one or more channels of data per time increment of the pseudo-random sequence. These data were computer-processed to obtain the crosscorrelation between the source intensity and the neutron density at various positions in the system. The crosscorrelation function was then converted into an impulse response function for the prompt neutrons by correcting for effect of delayed neutrons and the constant sidebands of the input autocorrelation function. The crosscorrelation technique has the advantage of eliminating most of the interference due to disturbances which are not correlated with the input. Furthermore, measurements can be taken rapidly since the pseudo-random signal gives approximately a 50% duty cycle for the neutron generator, thereby improving the statistical significance of data obtained in a given interval of time. The results were compared with conventional pulsed experiments on the same assembly. The technique has proven useful in the measurement of nuclear parameters related to shutdown reactivity of the system. (auth)

31507 (TRG-Report-439(Rev.)) THE ASSESSMENT OF PLUTONIUM CROSS-SECTION DATA BY FAST INTEGRAL EXPERIMENTS. A. G. Edwards (Reactor Group, United Kingdom Atomic Energy Authority, Dounreay (Scotland)). Dec. 2, 1962. 41p. Dep.(mn); $0.90(BIS); 4s. 6d. (HMSO).

Fast power reactors of the future are likely to be fuelled with plutonium and have critical masses in excess of a ton. It is desirable that the ability to calculate such systems should be checked against measured properties of zero energy critical assemblies. Yet for some time only a fraction of a ton of plutonium is likely to be available for this purpose. This limited quantity of plutonium can be used together with substantial quantities of uranium in mixed critical arrays, or systems comprising plutonium with a non-capturing diluent such as carbon can be studied. The two approaches are compared and found complementary rather than alternative. The former, though in some measure empirical, can be made to yield data immediately relevant to the power reactor of interest. The latter, though more fundamental, must be paralleled by work on the derivation of cross-section libraries from basic data if it is to assist power reactor design. (auth)

31508 (UNC-5064) GENERAL METHODS AND GRAPHS FOR EVALUATION OF EFFECTIVE CROSS SECTIONS USED IN DOPPLER EFFECT CALCULATIONS FOR FAST REACTORS. Charles C. Graves (United Nuclear Corp., White Plains, N. Y. Development Div.). May 1964. Contract AT(30-1)-2832. 101p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

General equations and graphs are given to permit calculation of effective cross sections in the unresolved resonance region. Correction factors are given for the effects of averaging over neutron and fission width distribution functions, interference between potential and resonance scattering, resonance overlap, and fluctuations in total cross section. (auth)

31509 AN IMPROVEMENT ON SHAPIRO'S APPROXIMATION TO A FUNCTION OCCURRING IN THE THEORY OF RESONANCE ABSORPTION. M. H. McKay (Univ. of New South Wales, Kensington, Australia). J. Nucl. Sci. Technol. (Tokyo), 2: 117-20(Apr. 1965).

Investigation of Shapiro's approximation for $\int_{-\infty}^{\infty}[\psi(x,\xi)]^n$ dx, where $\psi(x,\xi)$ is the line-shape function of frequent occurrence in the theory of resonance absorption, has led to a much more accurate approximation to this integral. The improved approximation is shown to be particularly advantageous for $\xi \simeq 1$, for which Shapiro's approximation is not very accurate. (auth)

31510 EXPERIMENTAL AND THEORETICAL STUDIES OF HEAVY-WATER HOMOGENEOUS TWO-REGION SYSTEM. Jitsuya Hirota, Satoru Katsuragi, Reiko Saito, and Takehiko Yasuno (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 132-40(Apr. 1965).

A series of critical experiments and theoretical analyses was made on two-region systems in which a heavy water solution of uranyl sulfate with ^{235}U enrichment of about 20% is surrounded by heavy water, poisoned with B or mixed with ThO_2. D-to-^{235}U atomic ratios in the core solutions ranged from 1000 to 4500, depending on the core diameter and the blanket concentration. The theoretical effective multiplication factor is decreased by treating the leakage of fast neutrons from the core rigorously and is increased by using spatial-dependent effective cross sections. These treatments are justified by the agreement found between

the calculated and measured values for the Cd ratio and the thermal flux distribution. The disagreement seen in the effective multiplication factor between the theoretical and experimental values may be attributed to uncertainty in the resonance integral of ^{235}U. The discrepancy in the effective multiplication factors does not exceed 1%, when the accepted value of $\nu I_f - I_a$ is reduced to a smaller value. (auth)

31511 APPLICATION OF THE RESPONSE MATRIX METHOD TO CRITICALITY CALCULATIONS OF TWO-DIMENSIONAL REACTORS. Katsutada Aoki and Akinao Shimizu (Nippon Atomic Industry Group Co. Ltd., Japan). J. Nucl. Sci. Technol. (Tokyo), 2: 149-59(Apr. 1965). (NP-14504)

The response matrix method was applied to criticality calculations of two-dimensional reactors. The response matrices of component blocks in a reactor were first calculated analytically with the group-diffusion approximation. Then the multiplication factor and the associated eigen currents, together with the mean flux in all the blocks into which the reactor was divided, were determined from these matrices by an iteration method. The proposed method was found by numerical comparison to be more efficient than the finite difference method, and to reduce the execution time appreciably. (auth)

31512 AN ANALYTICAL SOLUTION OF MULTI-GROUP REMOVAL-DIFFUSION EQUATIONS, IN PLANE MULTI-LAYERED, REACTOR SHIELD SYSTEM. L. W. Szymendera (Royal Coll. of Science and Tech., Glasgow). Nucl. Struct. Eng., 1: 476-91(May-June 1965).

The analytical solution is given for the set of differential equations describing, in the multi-group removal-diffusion approximation of Boltzmann's transport equation, the neutron flux distributions in the multi-layered plane shield of a nuclear reactor. The solution was obtained in closed form of a linear combination of some well-defined auxiliary expression, which can be easily integrated and differentiated. (auth)

Design and Feasibility

31513 (CONF-650501-6) THE AUTOMATION OF REACTOR DESIGN CALCULATIONS AT THE KNOLLS ATOMIC POWER LABORATORY. E. D. Reilly, Jr., and W. H. Turner (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd]. Contract W-31-109-eng-52. 16p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From the Application of Computing Methods to Reactor Problems, Argonne, Ill.

The history of automation of reactor design calculations at KAPL is reviewed chronologically, through the IBM 704, the Philco 2000 now in use, and the CDC 6600/6800 planned for the end of 1965. (T.F.H.)

31514 IMPROVEMENTS IN NUCLEAR REACTORS. (to Societe Anglo-Belge Vulcain, S. A.). British Patent 979,079. Jan. 1, 1965. Priority date Mar. 9, 1961, Belgium.

A nuclear reactor is described in which fluids, e.g. the moderator, at variable temperatures are brought to the center of a distribution network formed by elastic branches. The elastic arms are fitted to the chamber by rigid metallic fittings installed when the reactor is cold and that remain strictly centered plumb with the chamber while the elastic arms become deformed in case of variations of temperature of the fluid. This flexibility ensures that the fluid is led to the places of its utilization even at variable temperatures while dangerous stresses are avoided. (B.L.M.)

31515 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR INSTALLATIONS. James Bernard Terry and Cyril Percy Smith (to United Kingdom Atomic Energy Authority). British Patent 983,263. Feb. 17, 1965. Filed July 6, 1962.

A nuclear reactor installation includes a containment building, a reactor pressure vessel containing the core, and a heat exchanger vessel. The vessels have dependent portions free to expand under operating conditions, and closed circuit ducting interconnects the dependent portions and a pump in the circuit. The ducting includes a duct for leading coolant from the pressure vessel in an upwardly inclined direction to the exchanger vessel. A vertical duct leads from the heat exchanger to the inlet of the pump, and the outlet of the pump communicates with a return ducting leading to the pressure vessel. The vessels are cylindrical and are supported with their axes parallel and vertical with the return ducting extending in a horizontal plane. (B.L.M.)

31516 METHOD AND MEANS FOR CONTROLLING THE QUANTITY OF FISSION GAS IN HOMOGENEOUS BOILING REACTORS. Olle Lindstroem (to Allmanna Svenska Elektriska Aktiebolaget). U. S. Patent 3,166,478. Jan. 19, 1965. Priority date Dec. 2, 1959, Sweden.

In a homogeneous boiling-water reactor a permanent gas is introduced into the system for taking up fission gas in its passage in the system. The permanent gas is selected from the group D_2, He, O_2, H_2, N_2, Ne, or Ar. At least one storage tank containing the permanent gas is connected to the system on both sides of the condenser by means of conduit. A gas conveying means is provided for conveying the gas through the closed circuit. The volume of the permanent gas mass is at least half the volume of the reactor core. (B.L.M.)

31517 HOMOGENEOUS BOILING REACTOR. Olle Lindstroem (to Allmanna Svenska Elektriska Aktiebolaget). U. S. Patent 3,166,480. Jan. 19, 1965. Priority date Dec. 1, 1959, Sweden.

A boiling homogeneous reactor includes a pressure vessel and an inner container having an opening and containing fuel as a fissile material in either light or heavy water. The steam is evaporated from the water while the fissile material is left in the inner container. The inner container is arranged substantially within the lower portion and in spaced relationship to the pressure vessel. A reflector chamber for receiving the condensate from the steam is formed and a pressure equalizing space is defined between the pressure vessel and the inner container. The equalizing space above the inner container is connected to both the inner container and reflector chamber, and condensing means are connected with the space. The level of fuel in the inner container and of condensate in the reflector chamber is below the upper opening of the inner container. Means are provided for leading the condensate from the condensing means to the reflector chamber and at the bottom of the inner container for returning the condensate from the reflector chamber to the inner container. (B.L.M.)

31518 NUCLEAR REACTOR REFUELING SYSTEM. Peter J. Collins and Stephen N. Tower (to Canadian Westinghouse Co., Ltd.). U. S. Patent 3,167,481. Jan. 26, 1965. Priority date Aug. 30, 1958, Canada.

A heterogeneous pressurized-water reactor is described in which the large, thick-walled pressure vessel is replaced by a series of individual pressure tubes maintained in a closely spaced array. In this reactor, the pressure vessel can be of nominal thickness, and the individual pressure tubes can be relatively thin due to their relatively small cross-sectional area. The pressurized-water coolant is contained in the tubes at operating pressures that correspond to those of ordinary pressurized-water reactors. The individual tubes are insulated by a baffle arrangement so that the moderator fluid maintained outside the pressure tubes exists at a lower temperature for more effective moderating. The insulating arrangement is such that the walls of the pressure tubes exist at a lower temperature and can be made of softer and less expensive alloys. Flow-controlling and port-closure devices are provided, which can be operated quickly and directly without hazard to personnel. The flow of coolant through the various pressure tubes can be adjusted relative to one another to meet operation conditions and to rectify hot-spot conditions. Fuel elements can be loaded and unloaded during operation of the reactor by fuel transporting and handling machinery, which

is operated remotely in part and directly in part, and the fuel can be continuously cycled through the reactor without shutdown. (B.L.M.)

Fuels

Refer also to abstract 30324.

31519 (GEAP-3771-15) HIGH-PERFORMANCE UO_2 PROGRAM. Quarterly Progress Report No. 15, October–December 1964. M. F. Lyons, ed. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 15, 1965. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 120p. (EURAEC-1312). Dep.(mn); $4.00(cy), 2(mn) CFSTI.

Irradiations were successfully terminated in the GETR Pressurized Water Loop. Profilometer measurements indicate extensive circumferential ridging on the pellet rods, which appears to be reduced through the use of hollow pellets. All four EX-12A fuel rods exhibited a very large activity concentration at the bottom of the fuel column, primarily from ^{109}Ru. X-ray-diffraction analyses of failure zones in two fuel rods revealed the presence of zirconium hydrides in both cases. The first successful capsule irradiation for direct measurement of UO_2 thermal conductivity was performed. Tungsten capsules containing molten UO_2 were heat treated at 2900°C for 4 hours without developing a leak. No severe attack of the capsules was observed, however, molten UO_2 penetrated into the grain boundaries to a depth of 10 to 20 μ in some areas. Repeated tests of stressed Zircaloy-2 wire specimens in an iodine atmosphere did not reproduce the cracking observed previously with tube specimens. The wire samples apparently creep, relaxing the initial applied stress. Iodine induced cracks in Zircaloy-2 and Rod 12C were found to be transgranular. Experimental results on iodine and cesium deposition on irradiated fuel cladding are summarized. (W.L.G.)

31520 (ORNL-TM-1141) REFABRICATION TECHNOLOGY FOR THE THORIUM–URANIUM-233 FUEL CYCLE. A. L. Lotts and D. A. Douglas, Jr. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 32p. (CONF-650615-1). Dep.(mn); $3.00(cy), 2(mn) CFSTI.

From IAEA Panel on Utilization of Thorium in Power Reactors, Vienna.

To achieve low power costs, various reactor systems that would use the thorium–uranium-233 fuel cycle depend to a great extent upon the cost of fuel cycle operations. Since the fabrication of fuel is a major contributor to the cost of any fuel cycle, economical techniques of refabricating fuel must be developed. A discussion is presented of the factors which should be considered in the refabrication of bred fuel and of the ORNL approach toward solution of the problems encountered. This is followed by a discussion of the types and features of fabrication plants that should be employed for various recycle schemes and isotopes. Methods of minimizing refabrication cost are included in an analysis of refabrication technology for two types of fuel elements, that for high-temperature gas-cooled reactors and that for the Spectral Shift Control Reactor (SSCR). The ORNL refabrication program and the Thorium–Uranium Recycle Facility (TURF), which is to be used for pilot-scale demonstration of refabrication technology, are described. An analysis is made of the effect of production rate and isotopic content of fuel on refabrication cost. (auth)

31521 (WCAP-3385-3) SAXTON PLUTONIUM PROGRAM PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Apr. 1965. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3385. 54p. (EURAEC-1368). Dep.; $3.00(cy), 1(mn) CFSTI.

Activities in a program to develop information concerning the utilization of Pu-enriched fuel in pressurized water reactor systems, through design, fabrication and operation of a partial core of PuO_2–UO_2 fuel in the Saxton reactor are reported. The nuclear fuel design and design of special types of fuel rods were completed. Final critical measurements programs were developed and analysis of specific configurations was completed. Kinetic results indicate that a lower temperature will result from a transient in the planned mixed oxide PuO_2–UO_2 critical experiments than for the same reactivity addition in the UO_2 criticals. A fuel shipping-container design was found to be safe nuclearly for shipment of four Saxton 9 × 9 assemblies. Criticals were run with 5.7% enriched pelletized UO_2 fuel rods. Criticals with pelletized PuO_2–UO_2 fuel rods are scheduled. (J.R.D.)

31522 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Jacques Andre Stohr (to Commissariat a l'Energie Atomique). British Patent 980,298. Jan. 13, 1965. Priority date Feb. 9, 1962, France.

A fuel element includes an externally sheathed cylindrical tubular member of fuel material that has a cross section having a cruciform or star-shaped outer perimeter. The arms of the star have curved tips and are equiangularly spaced, and the tips of the arms of the star are joined by curves having a mean radius that is large relatively to the radius of curvature of the tips. The element has a central passage designed to reduce the thickness locally at the joining-point of the radial arms. The passage allows for an auxiliary circulation of fluid and for an increase in the size of the element and the power it can deliver. (B.L.M.)

31523 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. John Darrell Lancaster (to Babcock and Wilcox Ltd.). British Patent 980,316. Jan. 13, 1965. Filed Jan. 4, 1961.

A finned reactor fuel element can is designed for particular application to gas cooled reactors. The can is formed with longitudinal fins each extending circumferentially. The fins over different sections in the length of the can twist in opposite directions. This ensures, at least partially, that the unbalanced forces due to the flow of coolant in relation to the can may be caused to neutralize one another. The pitches of the fins in the different sections are equal or approximately equal, and the length of section(s) with fin twist in one direction is equal or approximately equal to the length of section(s) with twist in the opposite direction. This can is formed by extruding a can with longitudinal fins, passing the tube out of a die at a temperature at which the tube is readily deformable, cooling the tube as it passes away from the die to make it relatively rigid, and exerting a twisting force first in one direction and then in the other direction to impart a permanent set to the metal. (B.L.M.)

31524 IMPROVEMENTS IN OR RELATING TO CONTAINERS FOR NUCLEAR FUEL. Hans Beutler and Stefan Mayerhofer (to United Kingdom Atomic Energy Authority). British Patent 982,095. Feb. 3, 1965. Filed Dec. 1, 1961.

A nuclear fuel container for use in a reactor has a wall that encloses an inner fuel volume and a vent by way of which pressure differences across the wall can be equalized. The wall is formed of a material such as graphite having a permeability of the order of 10^{-6} cm^2/sec. The container is cylindrical in shape and may be closed by means of a simple screw-threaded joint rather than a brazed joint between container and lid. (B.L.M.)

31525 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR A NUCLEAR REACTOR. Henry Lloyd (to United Kingdom Atomic Energy Authority). British Patent 982,343. Feb. 3, 1965. Filed Sept. 14, 1963.

In a fuel plate type element, the plates are axially spaced along apertures in a tubular member at right angles to the member. The apertures in the tube connect with coolant channels between the plates. The plates are assembled between two parallel end walls and side walls that are somewhat thinner than the end ones. The side walls are

provided with projecting abutment means for spacing apart the adjacent fuel elements so that the adjacent side walls of the element are supported against outward distortion. The plates are additionally apertured to promote coolant cross flow, and the apertures are lined to prevent exposure of the fuel plate core to the coolant. (B.L.M.)

31526 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. David Frederick Hart and Michael Desmond Aston (to United Kingdom Atomic Energy Authority). British Patent 983,218. Feb. 10, 1965. Filed May 30, 1962.

An elongated sheath for a fuel element has a herringbone configuration of fins and a plurality of lugs spaced from one another longitudinally and transversely relative to the sheath. The lugs project beyond the outer edges of the fins, and when the sheathed element is in the reactor, the lugs contact the channel wall to resist the action of forces tending to cause bowing of the element during operation. The lugs may take different forms depending upon whether they serve a dual purpose, and they may be an integral part with the sheath or may be attached to it. The lugs at the end of the sheath are substantially rectangular, and the radial lugs may have end edge profiles that are inclined to the longitudinal axis of the sheath so as to provide a lead-in and lead-out configuration. At least one of the lugs has mounted within it a sleeve adapted to support and guide thermocouple leads carried along the length of the sheath and outside the fins. (B.L.M.)

31527 NUCLEAR REACTORS AND FUEL ELEMENTS THEREFOR. Shirley Russell Hopkins (to United Kingdom Atomic Energy Authority). U. S. Patent 3,158,548. Nov. 24, 1964. Priority date July 4, 1961, Great Britain.

A string of fuel elements is suspended by a cable sling for assembling before insertion into a reactor core as a column of superposed elements. In each element two open-ended metal tubes extend continuously at diametrically opposed positions between a metal spider at the top and a bridge at the bottom of the string of elements to form enclosed channels through which the cable sling passes. The lengths of cable extending above the element string are encased in flexible metal conduits. The conduits have their ends anchored in common by clamping between the halves of a split dolly. The string of fuel elements pre-assembled outside the reactor vessel is introduced into the core by lowering from the charge face. When the string is settled into the reactor, one end of the cable is freed at a winding drum, and the cable is pulled from the fuel elements. The dolly is withdrawn and the fuel elements are left unlinked in the reactor core with only the fitting tubing remaining from the equipment necessary for the fueling operation. (B.L.M.)

31528 FLEXIBLE FUEL BUNDLE FOR CONTINUOUSLY REFUELED NUCLEAR REACTORS. William F. Beutel (to Martin-Marietta Corp.). U. S. Patent 3,167,484. Jan. 26, 1965. Filed Dec. 12, 1961.

A fuel bundle is provided for continuously refueled reactors of the type that includes a variable-contour feed track for mounting and progressively feeding a plurality of such bundles into the core of the reactor. Such bundles are fed in tandem relation along the track. The bundles include a plurality of fuel tubes and are flexible and adapted to conform to the variable contours of the track. Flexible means connect the fuel tubes in a spaced parallel arrangement perpendicular to the track. Bearing means are provided on the flexible connecting means to engageably follow the feed track and to cause the flexible means and the parallel arrangement of fuel tubes to conform to the variable contour of the feed track as the fuel bundle progresses along. (B.L.M.)

Power and Power-Breeder Reactors

Refer also to abstracts 30978, 31459, 31495, 31611, 31612, and 31613.

31529 (AECL-2211) CONCEPTUAL DESIGN OF A NATURAL URANIUM BOILING LIGHT WATER REACTOR. G. L. Brooks and G. A. Pon (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1965. 26p. Dep.; $1.00(AECL).

CANDU-PHW type nuclear power plant is competitive today with other types of thermal power plants in unit sizes of 500 Mw(e) or more. The merits of removing heat from pressure tube reactors with light water have been obvious and recent developments show that the concept is practical. Advantages of light water as a coolant are: eliminates the major source of unavoidable heavy water loss and therefore reduces the tritium hazard to personnel, reduces the fear of a major heavy water loss to a negligible level, and makes the use of a direct cycle entirely practical. 1971 is the expected date for operation of this new reactor design. (F.S.A.)

31530 (ANL-7010(p.77-177)) FAST REACTORS. (Argonne National Lab., Ill.).

Activities related to fast reactor development are summarized. Most of the studies are oriented toward fast power breeder reactors; some work is directed toward development of fast spectrum nuclear rockets. Many neutronic problems in the two general areas of application are closely related. Papers are included on general fast reactor research and development, support of project activities, fast reactor safety, and general studies of fast reactor concepts. (J.R.D.)

31531 (BAW-3466-1) ZERO POWER TESTS, SM-1A CORE III. M. L. Batch, R. M. Ball, R. W. Lewis, and T. G. Pitts (Babcock and Wilcox Co., Lynchburg, Va.). Apr. 1965. Contract AT(30-1)-3466. 139p. Dep.(mn); $4.00 (cy), 3(mn) CFSTI.

The zero power tests on SM-1A Core III were performed. The core was assembled using grid plates, a skirt, control rod boxes, and a shield mockup especially constructed for the tests. (auth)

31532 (BMI-X-151) SURVEY OF ZIRCONIUM, YTTRIUM, AND CERIUM HYDRIDES FOR REFLECTOR APPLICATION IN THE GCRE. J. M. Fackelmann, M. A. Gedwill, Jr., and H. H. Krause, Jr. (Battelle Memorial Inst., Columbus, Ohio). Mar. 7, 1960. Contract W-7405-eng-92. 86p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Ce, Y, and Zr hydrides are compared on the basis of H atomic density, structural properties, thermal stability, neutron absorption cross sections, moderating characteristics, fabrication, cladding, radiation effects, and hydrogen retention, permeation, and migration. For Y and Zr hydrides and Y and Zr metal, comparisons are carried out of reactions with nitrogen, availability, costs, and purity. The performances of the hydrides as a reflector for GCRE-II are evaluated and compared. 59 references. (T.F.H.)

31533 (BNL-909) FACTORS IN THE ECONOMICS OF A SETTLED BED REACTOR. Jack Chernick (Brookhaven National Lab., Upton, N. Y.). Sept. 1964. Contract [AT (30-2)-Gen-16]. 37p. Dep.; $2.00(cy), 1(mn) CFSTI.

Stability and economics of settled-bed breeder reactors are analyzed. The settled-bed concept considered consists of a randomly packed bed of fuel pellets, held in place by the downward flow of the liquid-metal coolant. The fuel may be redistributed by flow reversal in order to achieve uniformity of fuel burnup. (T.F.H.)

31534 (BNL-9007) COUNTERCURRENT REFUELLING IN THE ORDERED BED FAST REACTOR. W. E. Winsche, J. Chernick, L. G. Epel, L. Green, and M. M. Levine (Brookhaven National Lab., Upton, N. Y.). Mar. 1965. Contract AT(30-2)-Gen-16 . 6p. (CONF-650602-22). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn.

The economics of countercurrent refuelling in ordered-bed fast breeder power reactors is compared with that of other refuelling methods for similar reactors. For a 1000-Mwe plant, the former refuelling method is shown to be economically superior. (T.F.H.)

31535 (COO-651-12) ELK RIVER REACTOR TWENTY-EIGHTH MONTHLY OPERATING REPORT, FEBRUARY 1965. (Rural Cooperative Power Association, Elk River, Minn.). Contract AT(11-1)-651. 33p. Dep.(mn); $2.00(cy), 2(mn) CFSTI.

Operation of Elk River Power Reactor is summarized. Shutdown, removal and changing of the central control rod, and startup are described. The status of various projects involved in the reactor operations is summarized. (T.F.H.)

31536 (CVNA-232) TRANSIENT DNB TEST ON CVTR FUEL ASSEMBLY. L. S. Tong, A. A. Bishop (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.), J. E. Casterline, and B. Matzner (Columbia Univ., New York. Electronics Research Labs.). Mar. 1965. Contracts AT(30-1)-2289 and AT(30-3)-187. 31p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Transient DNB has been tested on an electric heater mockup of a CVTR fuel assembly under two types of transient conditions. The power transient of a reactivity accident was simulated by a ramp increase of electrical power to the heaters. The flow transient of a loss of flow accident was simulated by a controlled flow coast down in a testing loop. The data of the steady state DNB tests are all greater than the predicted value based on the W-2 modified correlation. The power transient test results indicate that the CVTR reactor, operating at 65 Mwt with 80% flow, can stand a power excursion of 40% without reaching DNB. The flow transient test results indicate that the CVTR reactor, operating at 65 Mwt continuously without power decay, can stand a flow coast down up to 10 seconds without reaching DNB. The results with power decay (reactor scram) are even more encouraging. The test section can operate at 67% overpower and then experience a flow coast down without reaching DNB. (auth)

31537 (GA-4569) TARGET—A PROGRAM FOR A 1000-Mw(e) HIGH-TEMPERATURE GAS-COOLED REACTOR. Quarterly Progress Report for the Period Ending, August 31, 1963. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Sept. 27, 1963. Contract AT(04-3)-167. 65p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Preliminary work associated with selection of a reference design for a 1000-Mwe gas-cooled reactor to demonstrate new features is described. Features such as breeding of fuel at high temperatures using a Th–^{233}U cycle, use of advanced fuel elements, use of a gas turbine coolant circulator, reduction of capital costs, and use of supercritical steam are planned. (J.R.D.)

31538 (GA-4937) TARGET—A PROGRAM FOR A 1000-Mw(e) HIGH-TEMPERATURE GAS-COOLED REACTOR. Quarterly Progress Report for the Period Ending November 30, 1963. (General Atomic, San Diego, Calif.). Feb. 21, 1964. Contract AT(04-3)-167. 50p. Dep.(mn); $2.00(cy), 2(mn) CFSTI.

Preliminary design, advanced fuel development, turbo-circulator development, and alternate fuel-cycle development are reported for the 1000-Mwe TARGET reactor, which is based on the HTGR design. TARGET incorporates breeding or near-breeding in the Th–^{233}U cycle. (T.F.H.)

31539 (GAMD-4737) STEAM CYCLE STUDIES FOR TARGET. K. Stadie and D. Rose (General Atomic, San Diego, Calif.). Jan. 30, 1963. Contract AT(04-3)-167. 25p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Hazards considerations and fundamental requirements of primary and secondary coolant systems for the development of nuclear steam generators are outlined. The effect of a change of cycle inlet conditions on the cycle efficiency is shown on TS diagrams for the Peach Bottom and ESADA steam cycles and for one possible cycle for TARGET. Comments are made on the steam conditions and a description is given of the possible steam cycles for TARGET. (L.B.S.)

31540 (GAMD-5278) TARGET PCRS PROGRAM—FIRST PLASTIC MODEL, EXPERIMENTAL RESULTS AND NUMERICAL ANALYSIS. C. Riparbelli (General Atomic, San Diego, Calif.). Nov. 25, 1964. Contract AT(04-3)-167. 21p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

An epoxy plastic model of a prestressed-concrete pressure vessel is constructed, instrumented with electric strain gages, and tested by internal pressure. The objective of the analysis is the design of a prestressed-concrete reactor structure for a 1000-Mwe reactor. The experimental results on the plastic model are compared with the numerical results of the IBM TARGET code, and the correlation between these two methods is shown graphically. The plastic model has no ceiling perforations. (T.F.H.)

31541 (GEAP-4767) DEVELOPMENT OF PULSED NEUTRON APPLICATION TO POWER REACTOR START-UP PROCEDURES. 11th Quarterly Progress Report, October 1–December 31, 1964. E. Garelis and P. Meyer (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 25, 1965. Contract AT(04-3)-189. 9p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The information obtained by the pseudo-random impulse technique for long correlation times is identical to that obtained by the repetitive pulsing technique. Experimentally it should be a simple matter to determine if the correlation time that yields an equilibrium pulse is sufficiently long to make the correction term due to the finite correlation time small. The observation that the pseudo-random impulse technique yields data equivalent to the repetitive pulsing technique is significant in that the methods used to treat the repetitive data can be applied directly to the pseudo-random data. This will not only yield more information by making it possible to measure the parameter ($k\beta/l$) but also should give more precise values of α. (auth)

31542 (HPR-59) HBWR QUARTERLY PROGRESS REPORT, OCTOBER–DECEMBER 1964. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Feb. 1965. 140p. Dep.(mn).

Plant operation, performance, and engineering are summarized along with research and development activities. (J.R.D.)

31543 (HW-72219) URANIUM PRICE SCHEDULES AND BRED FUEL VALUES. E. A. Eschbach and M. F. Kanninen (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Dec. 1964. Contract AT-(45-1)-1350. 82p. Dep.; $3.00(cy), 2(mn) CFSTI.

A basis is established for relating the value of a chemically separable bred fuel (plutonium) to the price of fully enriched uranium. It is shown in a hypothetical situation (wherein the bred fuel has the same nuclear properties as ^{235}U but is chemically distinguishable from ^{238}U which is separated after irradiation) that the value of the recovered bred fuel will be essentially equal to the price of fully enriched uranium regardless of the burn-up situation. This hypothetical concept is used to show that this relationship results from the mathematical representation of the cascade ^{235}U–^{238}U enrichment process upon which the AEC Uranium Price Schedule is based. Data from detailed value calculations are shown to substantiate the analysis of the hypothetical circumstance and to show that the value of plutonium is closely proportional to the price of fully enriched uranium. The credibility of these results is shown to stem from the chemical separability of plutonium and uranium which enables plutonium enrichment of uranium to serve two functions: (1) to exploit the low cost of ^{235}U associated with uranium cascade tails and (2) to recover the costs of isotopic enrichment of ^{235}U in ^{238}U. This dual function is contrasted with bred fuel systems involving no natural fissile species ^{235}U; namely, thorium and pure ^{238}U, in which the bred fuels can only serve function number (2) for which the value is proportional to the ^{235}U burn-up costs of the basic reference case. Included is an extensive theoretical analysis which shows that Hypothium value is made up precisely of two components: the corresponding uranium burn-up costs and the value of the chemical separability of Hypothium from uranium. The chemical separability function is principally the value of the second derivative of the price schedule. If the second derivative is positive, Hypothium value is greater than the

corresponding burn-up costs. Even so, Hypothium value is empirically related to the price of fully enriched uranium because the enrichment level of fully enriched uranium must be assigned arbitrarily. (auth)

31544 (IDO-28631) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. SUMMARY OF NUCLEAR PHYSICS EXPERIMENTS. Robert E. Quilici (Aerojet-General Nucleonics, San Ramon, Calif.). Jan. 1965. Contract AT(10-1)-880. 111p. Dep.; $4.00(cy), 3(mn) CFSTI.

Nuclear experiments performed on the GCRE Critical Assembly, GCRE-I, the ML-1-IA and ML-1-IB Critical Assemblies, and ML-1 are surveyed exhaustively. All these have heterogeneous water-moderated pressure-tube cores fueled with enriched U. (T.F.H.)

31545 (MND-2706-13) TUBULAR CORE DEVELOPMENT PROGRAM — PM CORE 3 MATERIALS AND PROCESSES STATUS REPORT. W. Brittain, E. Colbeth, J. McGrew, J. Mueller, J. Smith, B. Sprissler, L. Sundquist, and J. Trushin (Martin Co., Baltimore, Md. Nuclear Div.). Dec. 1964. Contract AT(30-1)-2706. 292p. Dep.(mn); $6.00(cy), 5(mn) CFSTI.

Selection of spherical, stainless steel coated UO_2 for the Core 3 fuel element is discussed. Refinements to the spheroidizing and coating process are described; methods were developed for reprocessing off-size spherical UO_2, for inducing central voids in the spherical particles and for increasing the yield of in-size particles. An autoclave wear test on potential clad-guide tube material couples for the Core 3 finger-type control elements was performed. Twenty-one wear couples were investigated. Best performance was achieved with 17-4 ph stainless steel and with electrolized (high quality chromium plate) materials. Mechanical feasibility of the finger-type control system was demonstrated in room-temperature performance tests. Effects of finger bow, misalignment, and method of finger attachment to drive plate were evaluated. Development of a fabrication process for the Core 3 fuel element is described. The method involves cold slurry extrusion of the tubular cermet core using a suitable binder, cold hydrostatic pressing to densify the core, and final hot gas isostatic pressing to complete densification and bond the tubular clads to the core. An experiment was designed to irradiate Core 3 type fuel samples in the pressurized water loop of the Oak Ridge Research Reactor. The maximum burnup achieved in a tubular sample was 14.89 atom percent of the contained U-235; coupon specimens, which were also included in the test, achieved a U-235 burnup of 15.25 atom percent. (auth)

31546 (MND-3386) HYDROSTATIC TEST AND EXAMINATION OF A PM-1 CRDM ARMATURE HOUSING. (Martin Co., Baltimore, Md. Nuclear Div.). May 1964. Contract AT(30-1)-3386. 27p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

An examination was conducted on one corroded control rod drive mechanism armature housing that was removed from the PM-1 nuclear power plant. The results of the hydrostatic tests and metallurgical examination of the housing are presented, and recommendations are given. (D.L.C.)

31547 (NAA-SR-Memo-4967) PERFORMANCE REQUIREMENTS FOR HALLAM CONTROL RODS. R. L. Detterman (Atomics International, Canoga Park, Calif.). Mar. 17, 1960. Contract [AT(11-1)-Gen-8]. 30p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Calculations are carried out to determine the specifications for the Mark A and Mark B control rod of the Hallam Power Reactor. Particular emphasis is placed on the requirements for drive motor speeds, minimum rod sensitivities, reactivity rates for load following, minimum free-fall distances for safety rods, safety-rod-latch release times, minimum rates-of-fall of rods on scram, reactivity control margins, maximum allowable reactivity rates, and approximate rod duty cycles. (T.F.H.)

31548 (NP-14894) STABLE AND UNSTABLE MODELS OF POWER REACTORS. A. Peres, A. Gileadi, and J. Adir (Technion–Israel Inst. of Tech., Haifa and Technion Research and Development Foundation Ltd., Haifa (Israel)). Aug. 1962. 122p. Dep.(mn).

The system characteristics of nuclear-reactor power plants are specified, as a basis for describing specific reactor models. The transfer function for a reactor is derived. The Routh criterion is chosen for stability calculations. Stability calculations are carried out using Laplace-transform methods and direct analog-computer solutions of equations. Four power-reactor models are considered, namely PWR with and without pressurizer, and BWR with and without fuel-temperature fluctuations taken into account. Variations on these models are also considered. (T.F.H.)

31549 (NP-14897) A STUDY OF THE STABILITY OF HEAVY WATER NUCLEAR PLANTS BY MEANS OF ANALOG SIMULATION. D. Litai, A. Gileadi, and J. Wolberg (Technion–Israel Inst. of Tech., Haifa and Technion Research and Development Foundation Ltd., Haifa (Israel)). Apr. 1964. 74p. Dep.(mn).

The treatment of stability problems of nuclear plants by means of analog simulation is considered. The methods developed are applied to several heavy water natural uranium nuclear plants. The number of available amplifiers was small (thirty), so simple models of the system were essential. A one region model of the reactor and average values of the parameters were utilized. Diagrams of circuits which were used to simulate the reactor kinetics, heat transfer in the moderator and in the primary coolant loop, and in the heat exchanger and its secondary loop, are included. Diagrams are also included for simulation of the pressurizer, and of xenon poisoning. Analytical techniques were used to determine the range of stability of the system under consideration. Transfer functions of the system components were introduced, and a closed loop transfer function which includes temperature feedback was derived. The first plant considered utilized a pressure tube, heavy water moderated natural uranium fueled reactor of 125 Mw(e) net output. The responses of the system to various excitations were simulated. These included a step input of reactivity, a step change in coolant inlet temperature, changes in the coolant flow rate and in the pressure. From the point of view of stability the behavior of the plant was satisfactory. Large changes in fuel temperature were observed however, and these could prove to be dangerous if the fuel is operated near its metallurgical limit. It should be realized that the simulations were performed for cases in which no external control circuit was used. The control circuit of such reactors should therefore be designed in such a way as to minimize these large temperature changes. The second plant to be investigated was CANDU. Responses for several excitations were recorded. The results of the simulations were similar to those of the 125 Mw(e) pressure tube reactor. An attempt was made to find the minimum number of amplifiers required to simulate xenon spatial oscillations for the reactor. Good results were obtained with 18 amplifiers and 6 spatial points. These results agree to within 20% with those of Pearce. The final reactor investigated was of the boiling heavy water design. For this system a step function of 0.1 in reactivity caused a 10% increase in void fraction but did not cause instability. (auth)

31550 (NYO-3289-1) COMPARATIVE EVALUATION OF SINGLE- AND DUAL WATER-COOLED REACTOR POWER PLANTS. (Nuclear Utility Services, Inc., Washington, D. C.). Jan. 31, 1965. Contract AT-(30-1)-3289. 95p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

An analysis is carried out to estimate the cost differences between single and dual reactor installations, and to identify advantages and disadvantages of dual installations that are not amenable to precise cost evaluation. The studied range of outputs for the total installation is 150 to 1000 Mwe. Three types of reactors are considered in the study: pressurized water reactor with chemical shim control; PWR with spectral-shift control; and boiling water reactor. It is concluded that the costs are about equal for the two types of installations. (T.F.H.)

31551 (SRO-115) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, APRIL 1965. (Savannah River Operations Office (AEC), Aiken, S. C.). 11p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The performance of Zr and SAP clad ThO_2 and ThC fuel pins and Th metal nested fuel cylinders is outlined. Design criteria are laid out for a 1000-Mwe heavy-water organic-cooled reactor. Burnout tests of fog-cooled fuel-rod star clusters are reported. Zr–2.5% Nb pressure tubes are evaluated. CVTR operations are summarized. Development of the heavy-water organic-cooled power reactor concept is sketched. (T.F.H.)

31552 (TID-21757) ARDENNES NUCLEAR POWER PLANT QUARTERLY REPORT NO. 10, OCTOBER 1–DECEMBER 30, 1964. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, Chooz-Lez-Givet (France)). Jan. 27, 1965. Work Performed under United States–Euratom Joint Research and Development Program. 39p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Design studies of reactor and powerplant components are described. Engineering work on nuclear and conventional assemblies is summarized. Pictorial confirmation of construction progress is included. (J.R.D.)

31553 (TID-21785) HALLAM NUCLEAR POWER FACILITY MONTHLY OPERATING REPORT NO. 30, JANUARY 1965. (Consumers Public Power District, Hallam, Nebr.). Contract AT(11-1)-513. 90p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

The reactor suffered an outage that continued throughout January. Reactor operations, as well as steps taken to alleviate the outage, are reviewed. (T.F.H.)

31554 (TID-21793) NORA PROJECT PROGRAMME REVIEW, 1965. (Institutt for Atomenergi, Kjeller (Norway)). Mar. 1965. Contract AT(30-1)-2466. 13p. (NC-65). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Studies in NORA are reviewed, as applicable to the development of methods for design optimization for small and medium-size boiling-water power reactors. (T.F.H.)

31555 (TRG-Report-715) SOME STUDIES OF NOISE IN THE DOUNREAY FAST REACTOR. D. C. Menzies (Reactor Group, United Kingdom Atomic Energy Authority, Dounreay (Scotland)) and P. G. Bentley (Reactor Group, United Kingdom Atomic Energy Authority, Risley (England)). Jan. 20, 1964. Reprinted 1965. 26p. Dep.; $0.80(BIS), 3s. 9d. (HMSO).

Results are presented of an analysis of some recordings of fluctuations in the readings of several D.F.R. instruments. A short discussion of the theory involved in the analysis is included. Signals from several thermocouples and from an ion chamber were recorded with the reactor operating at 27 Mw and full coolant flow. Several interesting features were found in the analysis, including a resonance in the reactor flux noise spectrum at about 6 cps, a small positive temperature coefficient between the particular thermocouple measuring plenum inlet temperature and reactor power, and a large amount of low-frequency noise in all the signals. Some aspects of the transfer functions between different reactor instruments are considered, and an explanation of some of the results, in particular for the resonance at 6 cps, is suggested. (auth)

31556 (WAPD-MRP-112) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, January 24–April 23, 1965. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Contract AT(11-1)-Gen-14. 103p. Dep.; $2.50(cy), 3(mn) CFSTI.

Initial criticality for PWR Core 2 (Seed 1) was achieved on February 3, 1956. These tests indicate the one-rod-withdrawn shutdown reactivity, rod bank heights, and inferred excess reactivity to be within the expected limits. Core thermal capability was found to be adequate for operation of a 100 Mw(e) with new spare clusters installed to 7000 EFPH, and at 150 Mw(e) with spare blanket clusters replacing those at the low-density fuel cluster locations. Core thermal capability was significantly affected by the latest transverse power distributions. It was established that the thermally limiting core locations were correctly chosen, after a review of as-built data was made to provide assurance that all other locations were less limiting. Postulated release of 100% of the gas formed in the poison wafers was found to have a small effect on Core 2 capability. Fuel element failure curves for design limits were prepared for the seed and the blanket. The test to determine the ability to extrapolate core thermocouple corrections was evaluated. Procedures for detection and follow-up action during control rod malfunction conditions were identified. Cold criticality tests at Shippingport were performed under no flow conditions. The concrete enclosure emergency filtration system was tested at Shippingport. In-pile testing of both intentionally defected and undefected compartments up to exposures of 34.5×10^{20} fissions/cc continues to show the suitability of C-coated CaO-stabilized $ZrO_2 + UO_2$ fuel for PWR-2 Seed 2 application. The minimum design power ratio for Seed 2 operation is calculated to be 1.12. Design studies have continued for PWR Core 2 Seed 2. Final specification of the burnable poison requirements was reached during the period. Additional examinations of Core 1 components were completed with no adverse or unforeseen effects of operation noted. Evaluation of thermal data from Seed 4 operation was completed with the data showing satisfactory agreement with predictions. Modification of the steam generator structural support was completed. Refueling operations were completed. (auth)

31557 (WASH-1054(Pt.I)(p.15-34)) CONTROL DRIVE MECHANISMS FOR THE EBR-I REACTOR. B. C. Cerutti (Argonne National Lab., Idaho Falls, Idaho).

EBR-I is controlled by four types of control elements, all located in the outer blanket of the reactor. The operation, performance, and drive mechanisms of these four types of elements are summarized. (T.F.H.)

31558 (WASH-1054(Pt.I)(p.35-70)) EBR-II CONTROL DRIVES. E. Hutter (Argonne National Lab., Ill.).

The EBR-II reactor is described and shown graphically. The operation, performance, and drive mechanisms of the EBR-II control elements are summarized. (T.F.H.)

31559 (WASH-1054(Pt.I)(p.125-91)) DESIGN, TEST AND PERFORMANCE OF THE CONTROL ROD DRIVES FOR THE ENRICO FERMI REACTOR. J. G. Duffy, J. W. Hess, M. E. Leibson, and J. Matte, III (Atomic Power Development Associates, Inc., Detroit, Mich.).

The EFFBR reactor proper and general plant are described. The design, testing, and operational experience of the control and safety rods, and their guide tubes and drive mechanisms, are surveyed. The operating characteristics of the control and safety elements and drive mechanisms are tabulated. (T.F.H.)

31560 (WCAP-6075) YANKEE CORE EVALUATION PROGRAM. Quarterly Progress Report for the Period Ending March 31, 1965. M. J. O'Boyle, comp. and ed. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Apr. 1965. Contract AT(30-1)-3017. 110p. Dep.(mn); $4.00(cy), 3(mn) CFSTI.

Examinations of fuel assemblies and fuel rods have been completed. Also completed were control rod examinations and performance evaluations. This work included metallographic studies and tensile tests of specimens removed from both high- and low-exposure locations of the nickel plated, silver–indium–cadmium control rod irradiated in Yankee Core I. An error evaluation was initiated to determine the overall uncertainty in the assembly and total-core isotopic inventories and burnups. Also, a statistical analysis of the results obtained from a so-called "monitor" sample was performed to establish the precision of the mass spectrometric, Cs-137 radiochemical, and X-ray fluorescence analyses of spent fuel samples. An evaluation was completed on the results from preliminary, two-dimensional X-Y depletion calculations performed for the axially averaged Yankee Core I. This evaluation, which embodied comparisons of predicted with measured nuclear data, was used to appraise, on a

preliminary basis, two-dimensional, few-group, diffusion-theory computational techniques. (auth)

31561 THE POSSIBILITY OF USING THORIUM IN FAST POWER REACTORS. A. I. Leipunskii, O. D. Kozachkovskii, S. B. Shikhov, and V. M. Murogov. At. Energ. (USSR), 18: 342-50(Apr. 1965). (In Russian)

Studies of the possibility of using ^{233}U and thorium in reactor systems with expanded fuel breeding indicated that from point of view of doubling time there is the possibility of combined use of $^{233}U-Th$ and $^{239}Pu-^{238}U$ in a fast reactor mixed fuel cycle when the thorium is distributed in the reflector and ^{233}U, ^{239}Pu, and ^{238}U are in the active zone. The burnup and breeding ratio of ^{233}U and ^{239}Pu in mixed fuel cycle must remain constant. The doubling time in a fast reactor operating with the mixed cycle is much less than in reactors operating with ^{233}U and thorium exclusively. Thorium is the main breeder in the mixed fuel cycle. A method was developed for preparing isotopically pure ^{233}U containing only $\sim 10^{-6}\%$ of ^{232}U. (R.V.J.)

31562 THE AKB PROJECT—A NUCLEAR POWER PLANT WITH A D_2O MODERATED, CO_2 COOLED PRESSURE TUBE REACTOR FOR HIGH COOLANT TEMPERATURES. Hans-Joachim Preuss (Siemens-Schuckertwerke AG, Erlangen, Ger.). At. Strom, 11: 9-18(Feb. 1965). (In German)

The basic concept of the AKB project, the heat engineering data and the general layout of the complete installation are summarized. The heat circuits, reactor, fuel elements, fuel element transport system, control system, and auxiliary installations are considered in more detail. Problems connected with reactor security are discussed. (J.S.R.)

31563 FUTURE ENERGY NEEDS AND NUCLEAR FUEL USE. E. E. Smith and J. H. Wright (Westinghouse Electric Corp., [Pittsburgh]). Atomics, 18: 22-6(May-June 1965).

Consideration is given to the future nuclear generation system, uranium requirements in a mixed nuclear system, and uranium depletion effects on nuclear power costs. Basing calculations on AEC estimates of nuclear capacity, several important conclusions are made on the makeup of the future nuclear generating industry, the needs for and uses of nuclear fuels, and the economic effects of possible depletion of low cost uranium reserves. (P.C.H.)

31564 GAS SAMPLING FOR THE BBC/KRUPP HIGH TEMPERATURE REACTOR. H. Braun, J. Schoening, H. Landwehr, and B. Wolfram (Firma Brown Boveri/Krupp, Mannheim, Ger.). Atompraxis, 11: 185-91(Apr. 1965). (In German)

The safety problems in gas-cooled high-temperature reactors sometime require special designs. The necessity of containing the radioactivity that reaches the cleaning system and of checking the degree of contamination of the loops are considered. Facilities to be built in the BBC-Krupp reactor to take discontinuous samples from the loops and laboratory equipment for their analysis are described. Safety measures in operation of these facilities are discussed. (M.C.G.)

31565 REPORT OF THE ADVISORY COMMITTEE FOR THE PRODUCTION OF ELECTRICITY OF NUCLEAR ORIGIN ON THE PROSPECTS OF NUCLEAR POWER DEVELOPMENT IN FRANCE. Bull. Inform. A.T.E.N. (Assoc. Tech. Energie Nucl.), No. 51, 5-32(Jan.-Feb. 1965). (In French)

The committee had as its task the evaluation of the long-term and short-term advantages of rapid development of nuclear energy for France. The evolution of electrical production and the corresponding needs in primary energy were investigated. The present and future economic data on classical and nuclear power plants are discussed, and their uncertainties are indicated. The possible development of nuclear energy and the eventual difficulties in the industrial plan and the stocking of nuclear fuels are described. The priorities in the development of nuclear power plants are determined. (J.S.R.)

31566 THE E.L. 4 POWER STATION IN THE MONTS D'ARREE. J. Buttin (Indatom, Paris). Energie Nucl., 7: 73-82(Mar.-Apr. 1965). (In French)

An EL-4 power reactor prototype is being built in the Monts d'Arrée area. The major characteristics of the EL-4 reactor, which is moderated with heavy water and cooled with carbon dioxide under pressure, are discussed. The difficulties encountered and the solutions adopted, especially in the building of the stainless steel tank are considered. This tank contains the heavy water and the pipes containing the fuel elements (uranium oxide) pass through it; the carbon dioxide circulates in the pipes. Numerous difficult problems, due to the high quality required and the rigid specifications, were solved. (auth)

31567 CONSIDERATIONS ON FISSION PRODUCT RELEASE REDUCTION FACTORS OF POST INCIDENT DEVICES FOR NUCLEAR POWER PLANTS. Takashi Tagami (Hitachi, Ltd., Tokyo). Nippon Genshiryoku Gakkaishi, 7: 190-8(Apr. 1965). (In Japanese)

It is shown that in a loss-of-coolant accident of a nuclear power plant the amount of a specified nuclide among fission products released to atmosphere from the post-incident device system, consisting of an N-fold multiple barrier, can be approximately estimated by the simple formula $Q_L = \alpha_m Q_0 K_0 K_1 K_2 \ldots K_N$, where $K_n = \alpha_n \beta_n / \lambda + \beta_n + \xi_n$, $(n = 0,1,2, \ldots, N)$ is a fission product release reduction factor associated with the n-th barrier, Q_0 represents core fission product inventory of the specified nuclide, which has a decay constant λ, α_m is the core melt fraction, α_n is the fission product removal fraction due to plate out or absorption in at the n-th barrier, β_n is the leak rate from the n-th barrier, and ξ_n is the fission product removal rate due to containment spray, air recirculation, or natural steam condensation phenomena inside of the n-th barrier. Utilizing this formula, functions of various post-incident devices proposed for light-water-moderated power reactors in U.S.A. were surveyed with respect to the radioactive iodine release reduction effects. (auth)

31568 FABRICATION OF A 24 IN. VALVE FOR USE IN A REACTOR. Kiyoshi Yamanari (Okano Valve Mfg. Co., Japan). Tokushuko, 13: No. 10, 80-3(Oct. 1964). (In Japanese)

Water, CO_2, H_2, liquid metals, and organic liquids are used as cooling media in power reactors. A wedge-gate-type, main check valve 24 in. in diameter was experimentally constructed for use in the circulation system of coolant liquid. Stringent requirements are imposed on such a valve for reliability, leak tightness, corrosion resistance, etc. The specifications employed in the trial construction are: allowable pressure and temperature, 162 kg/cm^2 and 288°C, respectively; materials, austenitic stainless steel for the body and reinforcement and stellite hardening for the seating base; control, electromotive remote control; and closing time, 20 to 90 seconds. The ground packing was carefully designed, so that any leakage would be prevented, and for the valve rod, a flexible material was used to mitigate the impact. Stainless steels used had many advantages as a construction material, but had the drawback of sticking at high temperatures; this was overcome by welding stellite onto the contact surfaces such as the valve seat, guide, etc. However, the diffusion of carbon from the stellite caused intercrystalline corrosion and other defects; this difficulty was eliminated by special heat treatment. Tests with a strain gage showed that the valve is safe for the specified pressure. (NSA of Japan)

31569 COMPARATIVE ECONOMICS OF LARGE FOSSIL FUELED VS. NUCLEAR GENERATING STATIONS. M. H. Pratt (Niagara Mohawk Power Corp., Syracuse, N. Y.). 14p. (CONF-650429-6)

From American Power Conference, Chicago.

The comparative economics of large fossil-fueled versus nuclear power stations are discussed. Meeting construction schedules is considered. Economic studies on the Niagara Mohawk nuclear plant are described. (M.C.G.

31570 OPTIMUM NUCLEAR FUEL RESOURCE UTILIZATION. Simcha Golan (Atomics International, Canoga Park, Calif.). 30p. (CONF-650429-7)

From American Power Conference, Chicago.

Several approaches to the use of nuclear resources were examined in order to determine the path of minimum cost. It is shown that the system which offers the greatest potential for both reduced energy costs and greatly improved fuel utilization is the fast breeder reactor. The neutron economy and plutonium production of the heavy water reactor is also discussed. A comparison was made of uranium utilization by alternate reactor economies. The utilization of thorium is also considered. (M.C.G.)

31571 APPLICATION OF NUCLEAR ENERGY TO LARGE-SCALE POWER AND DESALTING PLANTS. Sidney Siegel, Simcha Golan, and Joseph A. Falcon (Atomics International, Canoga Park, Calif.). 24p. (CONF-650429-9)

From American Power Conference, Chicago.

Specific types of nuclear power plants in combination with desalting plants are examined to establish the relative economic potential of various heat sources for large-scale dual-purpose application. It was concluded that both technically and economically the dual-purpose approach has a decided advantage where a ready market exists for the power produced. (P.C.H.)

31572 POTENTIAL OF BWRs AS LOW COST HEAT SOURCES FOR DESALTING PLANT APPLICATIONS. F. E. Crever, M. J. McNelly, and E. H. Miller (General Electric Co., San Jose, Calif.). 23p. (CONF-650429-3)

From American Power Conference, Chicago.

Data are presented on the application of boiling water reactors to dual purpose plants, with emphasis placed on the costs of steam to the desalting plant for a wide range of pressures. The costs were computed on the basis of recently published information on product line boiling water reactors. The trend toward lower water desalting costs with lower steam pressures to the desalting plant, is noted. This trend has been confirmed, for certain conditions, in the case of boiling water reactor applications. Further appraisal of this characteristic of dual purpose plants has been attempted in order to assess the reasons therefore and to better define the most economical plant arrangement. The water production costs predicted by applying the present-day BWR to the water cost estimating methods 1 are comparable to those computed for future nuclear reactor concepts of several times the unit size (25,000 vs. 3,400 Mw(t)). Water production costs from medium size dual purpose installations based on present-day boiling water reactor technology may well fall within the range of economic feasibility based upon a computed 1975 power credit of 3.86 mills/kwh (private ownership). (auth)

31573 APPROACHES TO THE CONVERSION OF SEA WATER TO FRESH. Donald T. Bray and Thomas A. Johnston (General Atomic Div., General Dynamics Corp., San Diego, Calif.). 23p. (CONF-650249-4; GA-6294)

From American Power Conference, Chicago.

Discussion is presented on two methods for the desalination of sea water; dual-purpose plants making use of the High Temperature Gas cooled Reactor (HTGR) as the heat source and reverse osmosis, a membrane process. Process description, performance, and economics are considered. (P.C.H.)

31574 NUCLEAR REACTOR. (to Nuclear Materials and Equipment Corp.). British Patent 979,937. Jan. 6, 1965. Priority date Sept. 5, 1961, United States.

A reactor is provided that is fueled with Pu alone or together with other fissile and/or fertile material. The amount of ^{240}Pu and/or the moderation of the reactor is such that the effective neutron-absorption cross section of ^{240}Pu in the unconverted condition decreases substantially as the time of operation of the reactor increases. The decrease is sufficient to substantially compensate for the loss of reactivity associated with fission product buildup during operation. By virtue of the decreasing cross section of ^{240}Pu as the average neutron energy decreases during fuel consumption, the Pu becomes a self-stabilizing or self-compensating fuel. The quantity of Pu, its isotopic composition, and the moderation of the reactor is such as to compensate for the loss of reactivity of the fuel as the reactor operates. (B.L.M.)

31575 IMPROVEMENTS IN OR RELATING TO POWER CONVERSION SYSTEMS. (to General Dynamics Corp.). British Patent 980,281. Jan. 13, 1965. Priority date Jan. 2, 1963, United States.

A system is provided for effecting the conversion of thermal energy provided by a heat extracting medium circulating through an operating reactor into electric energy. The system includes a coolant loop with a circulator for circulating the medium through the reactor. A steam generator including a superheater and a reheater is connected to the reactor so that the heat extracting medium circulated through the reactor passes to the generator. A conversion unit connected to the generator converts part of the energy of the steam produced by the generator into electrical energy. Conduit means provides a path for steam from part of the conversion unit to the reheater, and a steam turbine is connected to the conduit means. The turbine is connected to the circulator so that steam passing through the conduit means to the reheater effects the driving of the turbine and the concomitant actuation of the circulator to establish the circulation rate of the heat exchange medium through the reactor. (B.L.M.)

31576 A METHOD OF OPERATING NUCLEAR POWER PLANTS. (to Esso Research and Engineering Co.). British Patent 980,373. Jan. 13, 1965. Priority date July 16, 1962, United States.

A method of operating a nuclear reactor is proposed that includes passing liquid benzene at supercritical pressure but below critical temperature into the reactor as moderator-coolant. The vaporized benzene is withdrawn from the reactor at supercritical temperature and pressure and passed through a turbine. Before complete passage through the turbine, the degradation products are removed to prevent reactor fouling. The liquid benzene from the heat exchanger is returned to the reactor, and the benzene vapor is condensed and returned under pressure to the liquid side of the heat exchanger. (B.L.M.)

31577 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR SYSTEMS. Ronald Scott Challender, John Michael Laithwaite, William Thexton Lawton, and Jack Jones Griffiths (to United Kingdom Atomic Energy Authority). British Patent 983,742. Feb. 17, 1965. Filed Nov. 2, 1960.

A reactor system includes a core contained within a spheroidal pressure vessel having coaxial inlet and outlet ducts connecting with the heat exchanger and means for circulating a pressurized coolant in closed circuit through the core and heat exchanger. The core and heat exchanger are supported in a plane that includes the axes of the coaxial ducts. The heat exchanger is supported by at least four hangers and is movable with respect to the pressure vessel to relieve thermal stresses in the ducts. The pressure vessel is supported by a series of like hangers. The relative lengths of the hangers are such that the plane of support including the ducts remains horizontal despite temperature changes in the system. The core is carried on a grid structure supported by a second series of hangers and the grid structure is stepped around the periphery to receive a complementary-stepped portion of the core. The hangers supporting the pressure vessel are coextensive with those supporting the grid structure carrying the core. (B.L.M.)

31578 LIQUID-METAL COOLED NUCLEAR REACTOR. Michel Chauvin (to Commissariat a l'Energie Atomique). German Patent 1,185,735. Jan. 21, 1965. Priority date Apr. 10, 1961, France.

The fuel elements of the described reactor are cooled

by circulating liquid metal and are mounted on a horizontal supporting plate that rests slidingly on a horizontal supporting surface. In order to prevent the corrosion of the supporting surface, means are provided to protect it against cavitation by the metallic coolant. This is substantially achieved with the aid of a plurality of calibrated coolant outlets in the supporting plate. (Gmelin Inst.)

31579 METHOD AND DEVICE FOR THE PROTECTION OF GAS-PURIFYING INSTALLATIONS IN NUCLEAR POWER PLANTS. Wilhelm Lehmer (to Gesellschaft fur Linde's Eismaschinen). German Patent 1,185,736. Jan. 21, 1965. Filed Dec. 2, 1958.

At least part of the purified blanketing and/or coolant gas flowing out of the purifier is recirculated into the purifying plant before it is used again in the reactor. (Gmelin Inst.)

31580 METHOD OF OPERATING NUCLEAR POWER PLANTS. James F. Black, William J. Sweeney, and Frank T. Barr (to Esso Research and Engineering Co.). U. S. Patent 3,162,580. Dec. 22, 1964. Filed July 16, 1962.

An operating procedure is described for a nuclear power plant in which benzene is used as the working fluid as well as the coolant and moderator for the reactor. The preheated liquid benzene at supercritical pressure is passed continuously into the reactor. In the reactor the heat of reaction raises the temperature of the benzene above its critical temperature, and radioactive degradation of part of the benzene results in high boiling polymers carried as vapors in the benzene passing through the reactor. The benzene at supercritical temperature is passed to a turbine, and the polymers are condensed as heavy liquid ends in the benzene as it is expanded with a pressure drop before complete passage through the turbine. Centrifugation between turbine stages removes the high boiling polymers as heavy liquid ends from the benzene. The effluent benzene vapor is withdrawn from the turbine under reduced pressure to a heat exchanger zone to effect heat exchange between the vapor and liquid benzene that is thus preheated and returned to the reactor. The benzene vapor is cooled to liquid and pumped back into the preheated circuit for reentry to the reactor. The overall thermal efficiency of the process is in excess of 40% while the working pressure of the reactor is maintained above the critical pressure of benzene and below about 1000 psi. (B.L.M.)

31581 HETEROGENEOUS NUCLEAR POWER REACTOR CORE STRUCTURE. Howard E. Braun (to General Electric Co.). U. S. Patent 3,166,481. Jan. 19, 1965. Filed Mar. 18, 1960.

An improved liquid cooled and moderated cellular structure core is described that is free of flux and power peaking. Elongated parallel moderating coolant flow passages, each separated from adjacent ones by a single wall of structural material, are provided through the core structure. A fuel element assembly is supported in each of a sufficient number of passages to maintain a self-sustaining chain reaction in the structure in the presence of the moderator. At least one movable control poison element is provided that has a geometric cross section substantially the same as one fuel element in the assembly. The control poison element(s) is provided with void or fuel followers reciprocally disposed in the chain reacting assembly to control neutron flux and power levels and secured to and axially aligned with the poison element. (B.L.M.)

31582 BOILING WATER REACTOR AND CONTROL THEREOF. John M. West and Walter H. Zinn (to Combustion Engineering, Inc.). U. S. Patent 3,167,480. Jan. 26, 1965. Filed Aug. 26, 1960.

The power output of a boiling water reactor is controlled by regulating the introduction of feedwater into the reactor system at locations such that the amount of sub-cooling of the feedwater as it passes through the reactor is controllably varied. The reactor is provided with a steam-separating drum that is separated from the reactor pressure vessel, and the drum forms part of the circulating system of the reactor and receives a steam and water mixture from the pressure vessel. In the drum the steam is separated from the water with the drum having an upper steam space and a lower water space. The steam is conveyed from the drum to a turbine, or intermediate heat exchanger, and water from the lower portion is conveyed back to the lower region of the reactor pressure vessel and then passes up through the core. The sub-cooled feedwater may be introduced by either having it sprayed into the steam space or introduced by a distribution conduit directly into the water in the lower protion of the drum, and a suitable control valve is provided to proportion the introduction into the two locations. This type control system is particularly well adapted for use with a two-pass reactor. (B.L.M.)

Process Heat Reactors

31583 (HPR-47) DEVELOPMENT AND APPLICATIONS OF DATA HANDLING AND PROCESSING AT HBWR. G. Kjaerheim, O. Vapaavuori, and J. Hannaford (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Nov. 1964. 96p. Dep.(mn).

A description is given of the various components of the data handling and processing equipment available for reactor or test loop signals at HBWR, and applications to transfer function measurements, in-pile calibration of gamma thermometers in an instrumented fuel assembly, the determination of steady-state hydraulic characteristics, and noise measurements are briefly discussed. (L.B.S.)

31584 THE USE UNDERGROUND OF NUCLEAR REACTORS. (to Siemens-Schuckertwerke AG). British Patent 983,614. Feb. 17, 1965. Priority date May 23, 1962, Germany.

An installation located underground for the purpose of utilizing to the fullest the fossilized fuels is described for nuclear reactors. The installation includes a reactor and a heat exchanger, which are included in a single constructional unit; and a reflector for the reactor. The reactor can function in a self-stabilizing fashion in operation. A fissionable material solution circulates round the reactor and heat exchanger combination by natural convection and exchanges heat in the heat exchanger with a cross countercurrent of a secondary medium, e.g. a naturally-occurring underground liquid. For initiating and controlling the reactor thin flexible pipes for the fissionable material solution and a protective gas connect the combination to the surface. Electric conductors connect electrical responsive devices in the unit to measuring instruments at the surface. (B.L.M.)

Production Reactors

31585 (HW-84330(Rev.1)) N-REACTOR CONVERSION—185-N GENERATING PLANT AUXILIARY POWER SUPPLIES. Roy C. Hoffman (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Nov. 3, 1964. Contract AT(45-1)-1350. 28p. Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

The design of conventional auxiliary power supplies for use during "cold-start" and "shutdown" status of the 185-N electric generating plant of the NPR is described. (T.F.H.)

31586 (ORNL-TM-1095) FABRICATION AND PREIRRADIATION DATA OF HFIR TARGET ELEMENTS FOR SAVANNAH RIVER IRRADIATIONS. J. D. Sease (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 50p. Dep.(mn); $2.00(cy), 2(mn) CFSTI.

Seven target elements containing ^{242}Pu were fabricated for irradiation in a reactor at Savannah River. Each element contained 10 g Pu in the form of 35 aluminum-clad pellets of PuO_2 dispersed in Al and pressed to 92% of theo-

retical density. The design and fabrication techniques resembled those for High Flux Isotope Reactor target elements. The pellets were sealed by welding in a helium-filled finned Al tube, which was then canned in a cylindrical Al sheath. The design and fabrication of the elements are described, along with results of examination of the completed elements, including photographs, radiographs, and complete dimensional data. (auth)

31587 (RL-NRD-105) CONTROL ASPECTS OF A LARGE, DUAL-PURPOSE NUCLEAR REACTOR PLANT. D. W. Leiby (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Dec. 1964. Contract AT(45-1)-1350. 35p. Dep.; $4.00(cy), 1(mn) CFSTI.

NPR is a graphite moderated, light water cooled pressure tube nuclear reactor. It has been designed to produce special nuclear materials as well as to utilize the process heat for the generation of up to 860 megawatts of electrical power. The control of the reactor itself is only a small portion of the total control requirements, the major portions being associated with the heat dissipation system. The variety and multiplicity of plant equipment, the interrelationships and feedback through the various systems, and the need for proper behavior during the transition between the various operating modes have required the installation of an extensive and complex array of control systems. NPR control requirements are developed. Major attention is devoted to descriptions of specific control requirements, design of systems to meet these requirements, and the performance of these systems in theory and practice as indicated by analytical studies and by actual plant operation. Included are descriptions of the reactor control rod drives; the primary coolant flow, pressure, and inventory controls; the steam generator level controls; the secondary system pressure, flow, and water inventory controls; and methods of determining both operating limits and performance criteria. (auth)

31588 HIGHEST NEUTRON FLUX. E. J. Hennelly. Nucl. News, 8: No. 6, 19-22(June 1965).

A description is given of the design, physics, and engineering of a heavy-water cooled and moderated high-flux reactor located at Savannah River. This reactor attained the highest sustained thermal neutron flux reported in a reactor to date. The reactor startup and performance are described. (W.L.G.)

Propulsion and Space

See also ENGINEERING — Space Propulsion.

31589 (AFCRL-64-865) ELECTRON AND PROTON FLUXES IN THE TRAPPED RADIATION BELTS ORIGINATING FROM AN ORBITING NUCLEAR REACTOR. Air Force Surveys in Geophysics No. 159. John C. Ringle, Ludwig Katz, and Don F. Smart (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Aug. 14, 1964. 30p. (AD-608784). CFSTI.

A simple calculation is done to determine the effects of an orbiting nuclear reactor on the trapped radiation belts. A SNAP-50 reactor, in an equatorial orbit at 1000 km and operating at 8 Mwt for a period of one year, is considered as a source of low-energy electrons and protons. Neutrons escaping from the reactor decay into electrons and protons and these can become trapped in the geomagnetic field. Hence, they contribute to the natural fluxes in the radiation belts. Three different source problems are considered: neutrons which decay within one kilometer of the reactor, within the entire inner radiation belt, and within the entire outer radiation belt. In each region the average equilibrium of reactor-produced electron and proton fluxes at the equator are calculated after reactor operation for one year. These fluxes are compared to the average natural electron and proton fluxes in the regions, and the reactor-produced fluxes are found to be less than 0.1 percent of the natural fluxes in all three cases. (auth)

31590 (AI-Memo-7585(Rev.2)) NUCLEAR SPACE POWER SYSTEMS. H. M. Dieckamp (Atomics International, Canoga Park, Calif.). Sept. 1964. Contract AT-11-1-GEN-8. 193p. Dep.(mn); $5.00(cy), 4(mn) CFSTI.

The state of the art of nuclear-reactor space power plants is reviewed. An investigation and survey is then presented of the reactor heat source design, heat rejection aspects, system design, and vehicle integration. As examples, SNAP 2, 8, and 10A are discussed in detail. 79 references. (T.F.H.)

31591 (CNLM-5983) INTERIM REPORT ON THE NUCLEAR TEST FACILITY DESIGN. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Aircraft Nuclear Engine Lab.). Nov. 30, 1964. Contract [AT(30-1)-2789]. 30p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Recommendations and comments are presented concerning the containment, safety, vacuum chamber, nuclear test instrumentation, facility and access requirements, and costs of the SNAP 50/SPUR Nuclear Test Facility. (T.F.H.)

31592 (GEMP-190F) INTRODUCTION TO NUCLEAR PROPULSION. Lectures 9 and 10. REACTOR THERMAL DESIGN. C. W. Moon (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Mar. 1963. Contract NAS8-5215. 124p.

A review is presented of a set of lectures on thermal-hydraulic characteristics of nuclear jet- and rocket-propulsion reactors. Examples and references are taken from existing and planned propulsion reactors. The topics covered include heat transfer, fluid dynamics, and design considerations and analyses. (T.F.H.)

31593 (GEMP-328) 630A MARITIME NUCLEAR STEAM GENERATOR. Progress Report No. 12. (General Electric Co., Cincinnati, Ohio. Advanced Technology Services). Dec. 31, 1964. Contract AT(40-1)-2847. 93p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

The current status of the 630A Nuclear Steam Generator program and highlights of the work performed from Oct. 1, 1964 to Nov. 30, 1964 are presented. Performance calculations and specifications were prepared for the 630A Mark IV power plant (27,300 SHP). Results of these calculations verify earlier estimates of 33.2 percent overall efficiency with 1500 psig, 1000°F steam conditions. A listing of pertinent specifications and operating characteristics was prepared on the 630A Mark IV system and appears in the Appendix. Configuration drawings and specifications were prepared for the 630A Mark V Nuclear Steam Generator. Its height is 39 feet, 1 inch; the diameter, 20 feet, 3 inches; and the overall efficiency, 33.7 percent. The hypothetical loss of coolant flow accident was analyzed for the 630A Mark IV, and peak temperatures were found to be several hundred degrees Fahrenheit below melting temperature of the cladding. Good agreement between critical experiment measured and analytical values was obtained for shim rod worths. Detailed calculations were made to determine the moderator temperature coefficient as a function of life. A heat balance for the end-of-life condition of the 630A Mark IV reactor was established. Isotopic history trace program 431 was revised to handle fissions in ^{236}U, ^{238}U, ^{239}Pu, ^{240}Pu, and ^{241}Pu to make it useful for the low enrichment 630A Mark V studies. The development and refinement of the 630A Mark IV reactor configuration was continued. Insulation requirements for the calandria were established. The preliminary configuration of the 630A Mark IV shield plug was revised for compatibility with the 75-inch outside-diameter of the calandria. The overall configuration of the 630A Mark IV pressure vessel utilizing carbon steel material was established. An activation study of the 630A Mark III calandria was made, and it was determined that the after-shutdown dose contribution of the calandria is negligible compared to the core. Fast neutron and primary gamma dose rates, secondary gamma dose rates, and heating rates at the core midplane for the 630A Mark IV configuration were extrapolated from previous calculations. Computer program input for shield analysis of the 630A Mark IV reactor–shield-plug assembly was completed. A new gamma source for the core was calculated. The overall configuration of the 630A Mark IV boiler was established. Leakage rates for the 630A Mark IV contain-

ment vessel were calculated for helium and air based on an assumed leak of 2.5 percent of the contained volume per day at 250 psig. The control rod actuator test rig, which simulates ship roll and other environmental conditions, was completed. The dynamic control rod actuator completed 3578 hours of testing. Work was begun on modifying the two-tube boiler test rig to incorporate steam flow measuring equipment. A subcontract was placed for a gas circulator study. The study has continued of the properties of 80Ni–20Cr fuel sheet made using spherically shaped UO_2. Determinations were made of the strength and ductility characteristics of this fuel sheet. An in-pile experiment was begun on a ring specimen made of this type of fuel sheet. The ring has accumulated 263 hours at a maximum temperature of 1400 to 1450°F. Preliminary evaluation is being made of spherical fuel made by the sol-gel process, and a capability for applying metallic coatings to fuel particles is being established. Creep strength studies of standard fuel sheet and cladding stock are continuing, and irradiation effects data were obtained on 80Ni–20Cr alloy. Indications are that, while pile ambient irradiation affects both stress rupture strength and ductility, the effects are significantly alleviated by annealing at 1500°F. The rolling mills installed in Building C were operated. A pilot quantity of fuel sheet is being prepared with the use of these facilities. In other work, the compatibility of 80Ni–20Cr alloy with PuO_2 is being evaluated in a study being sponsored at GE-HAPO, and a review was made of all GE-ANPD in-pile tests of Ni–Cr fuel specimens. A self-powered vehicle to raise the shielded reactor–shield-plug assembly and remove it from the ship without the use of cranes was proposed. The critical experiment was completely loaded to simulate the end-of-life condition. Reactivity measurements, fine radial, circumferential, longitudinal, and gross radial power measurements were made and are presented for the end-of-life core. Longitudinal heating rates at various cell positions were established. The moderator temperature coefficient in the end-of-life core was measured. An insert was designed for the critical experiment to permit a partial mockup of the low enrichment 630A Mark V core. (auth)

31594 (LA-DC-6842) THE LOS ALAMOS COUPLED KIWI-B4 EXPERIMENTS. C. G. Chezem, H. H. Helmick (Los Alamos Scientific Lab., Univ. of California, N. Mex.), and R. L. Seale (Arizona Univ., Tucson). [1965]. Contract W-7405-eng-36. 25p. (CONF-650610-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Institute of Aeronautics and Astronautics, Propulsion Joint Specialists Conference, Colorado Springs, Colo.

The interaction among the cores in a cluster of nuclear rocket reactors and the resulting static and kinetic behavior of the array has been studied analytically and experimentally. A lumped-parameter model of core-coupling has been analyzed and its salient features verified at zero-power by a variety of measurements on two Kiwi-type reactors operating in proximity. The Kiwi "free-space" coupling coefficients were measured to be 24.7, 11.9, and 3.3 cents at 6, 9, and 16 feet center-to-center separations. Calculations are in good agreement with these observations. Perturbation of the fission distribution as a result of interaction at equal power was less than 5% at 6 ft. No neutronic instability was found either in the theoretical models or in the experimental behavior. Temperature dependence is introduced into the coupling model based on experimental evidence from the high-power, full-flow operation of a single Kiwi reactor. The temperature-dependent model is then extrapolated to predict the behavior of both Kiwi and Phoebus clusters under operating conditions. No neutronic problems should arise in clustering and special shielding will not be required for stability. (auth)

31595 (LA-DC-7017) KIWI TNT — EVALUATION OF ENVIRONMENTAL EFFECTS. Harry S. Jordan, Robert V. Fultyn, Richard W. Henderson, and Philip K. Lee (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [nd]. Contract W-7405-eng-36. 3p. (CONF-650602-20). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn.

An outline is given of the environmental-radiation measurements and their analysis in the Kiwi-TNT experiment, in which the total activity released amounted to about 1.2 MC about 1 hr after the excursion. (T.F.H.)

31596 (MND-3169-47) RE-ENTRY DISPERSION MECHANICS OF PuO_2 MICROSPHERES. T. Olsen and L. Sullivan (Martin Co., Baltimore, Md. Nuclear Div.). Feb. 1965. Contract AT(30-1)-3169. 40p. Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

The availability of uniform size PuO_2 microspheres (5–125 μ radius) may affect the reentry programming of SNAP generator fuel capsules. An analytical model is presented for predicting the reentry trajectory and subsequent ground location of microspheres under specified conditions including horizontal winds. Calculated results are included for 10 μ and 100 μ radius PuO_2 particles released along the path of a fuel capsule reentering from a polar orbit. (D.L.C.)

31597 (NAA-SR-11129) SNAP-10A FSEM-3 AGENA COMPATIBILITY TEST. M. Teresa (Atomics International, Canoga Park, Calif.). June 15, 1965. Contract AT(11-1)-Gen-8. 39p. Dep.; $2.00(cy), 1(mn) CFSTI.

A summary is presented of the results of SNAP 10A/Agena developmental testing and final vehicle systems tests. Developmental testing was performed with the SNAP 10A FSEM-3 payload electrical simulator and an Agena Functional Mockup. FSEM-3 was utilized during vehicle systems testing prior to shipment of the Agena to the launch site. (auth)

31598 (NAA-SR-Memo-9817) SNAP-10A — PIPING STRESS ANALYSIS. Boulanger, J. R. (Atomics International, Canoga Park, Calif.). Jan. 22, 1965. Contract AT-11-1-GEN-8. 30p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A theoretical stress analysis was conducted on the SNAP 10A piping system. This system is made up of various sizes and shapes of stainless steel tubing welded together into a NaK containment network. Background information regarding the configuration and materials used, the loads and their sources, and the analytical verifications are provided. This analysis verifies the structural integrity of the system during both the SNAP 10A thermal and vibration environments. (auth)

31599 (NAA-SR-Memo-9897) 10FSM1 DYNAMIC TEST REPORT, SNAP-10A. Dauterman, W.; Gelman, A.; Henley, H. (Atomics International, Canoga Park, Calif.). Feb. 15, 1965. Contract AT-11-1-GEN-8. 68p. Dep. (mn); $3.00(cy), 2(mn) CFSTI.

The SNAP-10A FSM-1 system was subjected to launch-equivalent dynamic loads in the Environmental Test Laboratory. 50% Acceptance, Acceptance, and Qualification Vibration and Shock loads on each of the three axes constituted the test program. The FSM-1 system, the test laboratory, and the events of the loading sequence are described. The data obtained during the tests are described and evaluated. It is shown that the system successfully endured the qualification program. (auth)

31600 (NAA-SR-Memo-10695) EXPERIMENTAL STRESS ANALYSIS OF SNAP-2 REACTOR-VESSEL TOP-HEAD. Goodman, L. (Atomics International, Canoga Park, Calif.). Nov. 16, 1964. Contract AT-11-1-GEN-8. 23p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

An experimental stress analysis was performed on a model of the top head of the SNAP-2 Reactor Vessel. The resulting data are to be used in checking an analytical evaluation of the stresses in the top head. The data were obtained by applying various loads to the model to simulate components of the loading conditions expected during launch of the SNAP-2 System. The resulting maximum stresses from this analysis are given for the following load types: internal pressure, axial tension or compression on outlet pipe, bending of pipe at juncture with top head, transverse shear of pipe of juncture with top head, and torsion of pipe about its longitudinal axis. In nearly every case the maxi-

mum indicated stresses occurred at the juncture between the top head and the outlet pipe; the exceptions occurred for those loadings which produced the lowest stresses. The strain-gage data obtained from all of the test loadings when plotted as functions of the applied loads showed good linearity. It is probably safe to extrapolate the tabulated loads and stresses an additional 50%. (auth)

31601 (NASA-CR-54339) HIGH-TEMPERATURE MEASURING DEVICE. Final Report. E. H. Carnevale, L. C. Lynnworth, and G. S. Larson (Parametrics, Inc., Waltham, Mass.). Feb. 1, 1965. Contract NAS-3-5201. 68p.

Investigations of an ultrasonic pulse technique for measuring the average gas temperature in a nuclear rocket engine are presented. This includes a study of sound propagation in high-temperature gases, particularly hydrogen, and the effects of the nuclear rocket engine environment on the ultrasonic sensors. A working model, designed and constructed to illustrate the concepts and operation of a pulsed ultrasonic thermometer, is also described. (auth)

Research and Test Reactors

Refer also to abstracts 31459 and 31495.

31602 (AECL-2247) ANNULAR PELLET ROD MOCK-UP EXPERIMENT IN ZEEP. R. E. Green (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Apr. 1965. 9p. Dep.; $0.50(AECL).

Radial and axial flux distributions were measured in an annular UO_2 pellet rod mockup assembly installed in the ZEEP reactor. The measurements provided data necessary for the determination of heat transfer coefficients in an actual loop experiment being done in the NRX reactor, and also confirm that flux peaking at the ends of a fuel charge can be essentially eliminated by using stainless steel spacers as flux suppressors. (auth)

31603 (BNWL-71) FAST FLUX TEST FACILITY STUDIES. Progress Report. E. R. Astley, ed. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1965. Contract AT(45-1)-1830. 120p. Dep.; $4.00 (cy), 2(mn) CFSTI.

Work was performed on the conceptual design of the proposed Fast Flux Test Facility and information was obtained in areas of supporting technology. The studies for the FFTF were based on: maximum use of components already proven in sodium-cooled reactor service; maximum utilization of known sodium technology; planned maximum possible utilization of existing sodium technology facilities and sites for all required development. Additional conceptual design data were obtained on the tube-type reactor core, on the instrumentation system, on the type of building required and on the scope of Engineering Test Facility. In the area of supporting technology, information was obtained on physics, materials selection, driver fuel development, sodium technology, analytical chemistry requirements, program management technology, and fast-flux irradiation testing needs for structural materials. (auth)

31604 (HN-180) A STUDY OF RESEARCH REACTOR OPERATING AND SAFETY EXPERIENCE. B. J. Garrick, W. C. Gekler, J. M. Duncan, R. H. Karcher, and B. Shimizu (Holmes and Narver, Inc., Los Angeles, Calif.). June 12, 1964. Contract AT(04-3)-424. 675p. Dep.; $6.75(cy), 11(mn) CFSTI.

The operating and safety experience at ten research reactors is surveyed thoroughly. The reactors studied include CP-5, Battelle, IRL, and seven university research reactors. (T.F.H.)

31605 (HW-84575) NUCLEAR DESIGN CALCULATIONS FOR AN Hx–Pu FUELED MTR. R. H. Holeman and P. L. Hofmann (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Dec. 15, 1964. Contract AT(45-1)-1350. 47p. Dep.(mn); $2.00(cy), 2(mn) CFSTI.

Calculations of reactor statics and fuel cycles, and preliminary calculations of thermal-hydraulic design, are carried out for the MTR, assuming the fuel to be high-exposure (Hx) Pu. Results are tabulated and presented graphically. All reactivity determinations used in the calculations are based on a four-group, one-dimensional diffusion calculation. (T.F.H.)

31606 (HW-84614) FERTF PROGRAM PROGRESS AND PLANS. Quarterly Report No. 4, October–December 1964. J. A. Stoddard (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Contract AT(45-1)-1350. 6p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Progress is reported in the operation of the Fuel Element Rupture Testing Facility of the PRTR. (W.L.G.)

31607 (LA-DC-6786) FAST BURST REACTORS IN THE U.S.A. Thomas F. Wimett (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract [W-7405-eng-36]. 34p. (SM-62/53; CONF-650504-8). Dep.(mn); $2.00(cy), 1(mn) CFSTI.

From IAEA Symposium on Pulsed Neutron Methods, Karlsruhe, Ger.

Reactor design, description, performance, and safety characteristics are summarized for the U-fueled Lady Godiva, Godiva II, Kukla, Fran, and SPR-I, and the U–Mo–fueled HPRR, Molly-G (FBR), and Super Kukla. The technique for generating fast bursts in these reactors is outlined. (T.F.H.)

31608 (ORNL-3789(p.99-109)) FLUORIDE SALT PRODUCTION. J. H. Shaffer, W. K. R. Finnell, Wiley Jennings, F. A. Doss, W. P. Teichert, and C. E. Roberts (Oak Ridge National Lab., Tenn.).

Fuel for the Molten Salt Reactor Experiment (MRSE) was prepared as $^7LiF-BeF_2-ZrF_4$ fuel solvent mixture, $^7LiF-^{235}UF_4$ (27 mole % UF_4) fuel concentrate, and $^7LiF-UF_4$ mixture with 27 mole % of depleted UF_4; these mixtures are to be blended to the proper fuel composition in startup of the MSRE. The $^7LiF-BeF_2$ mixtures (coolant and flush salt) were prepared to the final composition in one operation. All purified melts were stored under pure He until needed. The coolant and flush salts were transferred into the MSRE tanks. The MSRE fuel is in final stages of preparation. (J.R.D.)

31609 (ORNL-3789(p.271-6)) RELEASE OF FISSION PRODUCTS DURING MELTING OF FUELS UNDER REACTOR TRANSIENT CONDITIONS. G. W. Parker, R. A. Lorenz, and J. G. Wilhelm (Oak Ridge National Lab., Tenn.).

Previously irradiated pellets of UO_2 clad in stainless steel were melted under moist air at 45 psia in the TREAT reactor; in each of two experiments, a reactor transient of 75 msec period melted the cladding and about 75% of the UO_2. Analysis of the gas, distribution of the fission products, and analysis of particle sizes of the gas-borne material were obtained. About one-third of the volatile fission products (I, Te, and Cs) were released from the UO_2, but less than 1% escaped from the fuel autoclave. The experimental assembly was modified to permit melting of miniature UO_2 fuel elements in steam at about 1000 psia and sampling of the gases, aerosols, and fission products produced. With this assembly, a stainless-clad and a Zircaloy-clad UO_2 specimen were exposed to 77-msec-period transients in TREAT. Effective operation of the valves to permit sampling was obtained in only one of the attempts. Analysis of the materials is in progress. (auth)

31610 (ORNL-TM-733) MSRE DESIGN AND OPERATIONS REPORT. PART VI. OPERATING SAFETY LIMITS FOR THE MOLTEN-SALT REACTOR EXPERIMENT. S. E. Beall and R. H. Guymon (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7495-eng-26. 5p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

The operating safety limits for the containment system, fuel system, coolant system, control rods, and nuclear control and safety instrumentation for the MSRE are tabulated. Also given are the personnel radiation monitoring procedures, personnel qualifications and procedures, and experimental limits. (T.F.H.)

31611 (ORNL-TM-909) MSRE DESIGN AND OPERATIONS REPORT. PART IX. SAFETY PROCEDURES AND EMERGENCY PLANS. A. N. Smith (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 58p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

The operation of the Molten Salt Reactor Experiment (MSRE) is subject to normal industrial hazards, such as fire, explosion, and airborne contamination, as well as to hazards peculiar to the production of nuclear energy. Emergencies may arise involving danger to personnel or damage to property. Basic guidelines, procedures, and background information are provided that will assist MSRE and supporting personnel in the anticipation, prevention, and handling of emergencies. (auth)

31612 (WASH-1054(Pt.I)(p.71-86)) FARET CONTROL DRIVES. E. Hutter (Argonne National Lab., Ill.).

The 50-Mw research reactor FARET (Fast Reactor Test Facility) is described. The operating characteristics of its control drives are tabulated, and the drives themselves are shown schematically. (T.F.H.)

31613 (WASH-1054(Pt.I)(p.87-102)) SEFOR CONTROL DRIVE SYSTEM. S. Stewart and William Zschaler (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.).

SEFOR is a 20-Mwt Na-cooled fast reactor, whose core is designed to be representative of those of large, fast, urania–plutonia-fueled power breeders, and which is intended to be used to study this type of reactors. SEFOR is controlled by moveable reflector elements, which surround the core outside the reactor vessel. The control rods, control drives, and drive mechanisms are described. The operating characteristics of these mechanisms, and the reasons for selecting the control and drive configurations used, are outlined. (T.F.H.)

31614 THE CORRELATION BETWEEN THE REACTOR POWER AND THE INTENSITY OF ČERENKOV RADIATION IN THE REACTOR. Sang Soo Lee and Dae Yoon Park (Atomic Energy Research Inst., Seoul). New Phys. (Korea), 4: No. 2, 59-64(1964). (In Korean)

The intensity of Cherenkov radiation in the Triga-II reactor was measured using a EMI photomultiplier and a simple optical system for imaging the beam tube to the photocathode. First the intensity of the Cherenkov radiation was correlated to the power of the reactor in the cases of rising and decreasing power. In the former case they are linearly correlated whereas in the latter the linearity is poor, yet they may be approximated with the equation between the normalized galvanometer deflection and the power. It is found that the correlation exists only above 750 w for the case of rising power and 400 w for the case of decreasing power. The Cherenkov radiation is found slowly increasing during the first 5 hours when the reactor is set to operate at 100 Kw. The increase of the Cherenkov radiation is in average equivalent to the power of 14 w per Kw and per hour. However, this increase ceases asymptotically in five hours. During the measurement for 7 hours at every 30 minutes, the galvanometer deflection and the power recorded in the linear recorder in the control console agreed reasonably well, the reactor being in operation at the nominal 100 Kw, and the discrepancy may be attributed to the disturbance in the electrical main. (auth)

31615 IRRADIATION FACILITIES (LITR) (Engineering Materials). (Oak Ridge National Lab., Tenn.). 15 drawings. (CAPE-1231)

Irradiation facilities used with the Low Intensity Test Reactor (LITR) are described. The V-2 facility operates at low thermal neutron flux, and is used for gas-cooled (air) experiments. The C-45 facility operates at intermediate thermal neutron flux (1×10^{13} n/cm^2/sec) and is also used for gas-cooled (air) experiments. (For Details, See TID-4100) (M.C.G.)

WASTE DISPOSAL AND PROCESSING

See also BIOLOGY AND MEDICINE — Ecology.
CHEMISTRY — Radiochemistry.
CHEMISTRY — Separation Processes and Procedures.
HEALTH AND SAFETY.

Refer also to abstract 30242.

31616 (AECL-2248) CRNL ACTIVE WASTE INCINERATOR. D. W. McQuade (Atomic Energy of Canada Ltd., Chalk River, (Ontario)). Feb. 1965. 52p. Dep.; $1.00 (AECL).

At CRNL, the daily collection of 1200 pounds of active combustible waste is burned in a refractory lined multichamber incinerator. Capacity is 500–550 pounds per hour; volume reduction 96%. Combustion gases are cooled by air dilution and decontaminated by filtration through glass bags in a baghouse dust collector. A description is presented of the incinerator plant, its operation, construction and operating costs, and recommendations for future designs. (auth)

31617 (ORNL-TM-1081) WASTE TREATMENT AND DISPOSAL SEMIANNUAL PROGRESS REPORT, JULY–DECEMBER 1964. F. L. Parker and R. E. Blanco (Oak Ridge National Lab., Tenn.). May 1965. Contract W-7405-eng-26. 168p. Dep.(mn); $5.00(cy), 4(mn) CFSTI.

Solidification tests of highly radioactive waste were completed using a 150-kw furnace. The 20-in.-dia, continuous, horizontal melter operated successfully for 250 hr until a hole formed in the melter as the result of corrosion. The average feed rate for the continuous melter was between 30 and 45 liters/hr for extended times. A computer code was developed for retrieving and correlating the mass of data generated in the program for developing glassy melts for the fixation of high-level waste. Initial read-out was obtained on 356 ORNL melt compositions. Melts containing simulated fission products from a fuel burnup of 10,000 Mwd/t were run in semiengineering-scale continuous melters. In these tests, phosphate volatility was generally <0.5%, and sulfate volatility <5.0%. There were anomalous results with these constituents as well as with Fe and Ru. Of candidate construction materials exposed in a continuous melter at 950°C, only Pt was unattacked. A 50% Cr–50% Ni alloy was relatively resistant and might prove usable in a melter operating at a lower temperature. Inconel ranked third. Stainless steel types 304L, 310, 347, and Carpenter 20SCb, Hastelloys B, C, and F, Ni-o-nel, Nichrome and BMI-HAPO 20 were the other materials tested. Aspects of foam separation in decontamination of low-radioactivity-level process waste water (LLW) were studied. Studies in support of the ORNL foam-separation pilot plant included an evaluation of various gas distributors and an analysis of the dynamics of a foam column having a square cross-section. The pilot plant work on the scavenging-precipitation foam-separation process was terminated. Mixed phosphates present in raw low-radioactivity-level waste (LLW) inhibited Ca precipitation in scavenging-precipitation ion-exchange processes. Use of ALCOA F-1 removed more than 99% of four phosphates tested for more than 3000 bed volumes (BV) (equivalent to 15,000 BV for a feed 1 ppm in phosphate) in downflow operation through a packed bed of solid. Evaluation of a water-recycle flowsheet was made consisting of (1) batch clarification of LLW using zeta-potential-controlled additions of coagulant aid, (2) demineralization of the supernatant through a mixed cation-anion ion exchange column, and (3) treatment with a column of activated C. Overall decontamination factors at 10% conductance breakthrough or 200 BV were estimated to be: >200 for ^{106}Ru, >1300 for ^{60}Co, 300 for ^{137}Cs, 1000 for ^{90}Sr, >600 for ^{144}Ce, and >25 for ^{95}Zr–Nb. Demineralization was accomplished for 175 BV with waste water and with tap water, 210 BV. Asphalt products containing 20 to 60 wt % solids from simulated ORNL waste-evaporator bottoms were leached with water for periods up to 9 months. The leach rate of an asphalt product containing 60 wt % solids was not effected by irradiation to an absorbed dose of 10^8 rads. An estimate of the costs of perpetual tank storage of wastes is being undertaken to establish a basis for comparison with costs for alternative waste-management schemes. Solution-dispersion coefficients were measured in Berea sandstone as a function of flow rate. The experimental values of the dispersion coefficients varied with the 1.22 power of the solution velocity. Preparations for demonstration of disposal of highly radioactive solid wastes in a salt mine are on schedule. Most of the topside facility and mine renovations are complete, and the waste-charging shaft has been installed. Mining of the experimental area is about 67% complete. In the lower 21 miles of the Clinch River, an inventory showed that about 200 curies of radioactivity are in the bottom sediments. Over three-quarters of it is ^{137}Cs. Other principal radionuclides found in the sediment are ^{60}Co, ^{106}Ru, ^{90}Sr, and rare earths. Comparison of the inventory to quantities of these radionuclides released over White Oak Dam seems to indicate that only the retention of Cs (about 20%) is important. The desorption of I_2 from Clinch River flood-plain sediment with either water or air gives a rapid initial desorption of the loosely bound I_2. This is followed by a slower desorption of more tightly bound I_2. The amount of bound I_2 is a function of the temperature of the system. (J.R.D.)

31618 (TID-21882) INVESTIGATION OF MATERIALS AND METHODS FOR FIXATION OF LOW AND MEDIUM LEVEL RADIOACTIVE WASTE IN STABLE SOLID MEDIA. Progress Report, August 1, 1964–January 31, 1965. R. C. Rastogi, J. D. Sehgal, and K. T. Thomas (Atomic Energy Establishment, Trombay (India)). Mar. 29, 1965. Contracts AT(30-1)-3431 and IAEA US/261. 34p. Dep. (mn); $2.00(cy), 1(mn) CFSTI.

A proposal is described, for fixation of spent vermiculite, incinerator ashes, and chemical sludges in vitreous matrices. Results on the fusion studies of the mineral vermiculite, the leaching characteristics of the fused mass, and the volume reduction ratios are given. The apparatus for studying volatilization loss is described. (auth)

31619 (AEC-tr-6549) REPORT ON THE PROBLEM OF THE POSSIBILITY OF THE UNDERGROUND DISPOSAL OF RADIOACTIVE WASTES. (Bundesanstalt fuer Bodenforschung, Hanover (West Germany)). Translation. [nd]. 77p. Dep.(mn); $7.60(fs), $2.51(mf) JCL.

Studies were carried out on the possible underground storage of large amounts of wastes in West Germany. Both aquiferous and cavern depots were considered, and various possible places in Germany are discussed. Salt deposits, masses, and structures are described in some detail. (D.L.C.)

31620 ON THE HEAT RELEASE FROM HIGHLY RADIOACTIVE SOLIDS IN RELATION TO THE PROBLEM OF WASTE DISPOSAL AND UTILIZATION. P. V. Zimakov, B. S. Kolychev, V. V. Kulichenko, and Yu. P. Martynov. At. Energ. (USSR), 18: 428-31(Apr. 1965). (In Russian)

An attempt was made to utilize the heat released from buried highly radioactive waste by melting vitreous preparations and retaining the necessary temperature in the burial container. Descriptions are given of an installation designed for electromodeling the heat release from melted highly-radioactive materials and for determining the temperature dependence in the burial container on the quantity

and specific activity of the buried block. Graphs are shown of the amount of fixation material which can be melted in the burial container containing 1 m^3 melted fixation mixture with the initial activity of 30,000 C/dm^3. It is shown that at the given temperature in the burial ground of highly active blocks it is possible to melt also large quantities of low activity calcinated wastes. The properties of melted highly active fission concentrates can be used for various purposes such as isotopic sources of power. (R.V.J.)

31621 MANAGEMENT OF RADIOACTIVE WASTES. Atomics, 18: 8-16(May-June 1965).

Various means used by AEC installations for the treatment and disposal of radioactive wastes are discussed. Treatments by fluidized bed calcination, fixation in glass, and long term storage or ultimate disposal are discussed separately. (P.C.H.)

31622 BACKGROUND INFORMATION ON ATOMIC POWER WASTE HANDLING. John F. Hogerton, James G. Cline, Robert W. Kupp, and Charles B. Yulish. New York, Atomic Industrial Forum, 1965. 50p. $1.50.

The handling and disposal of the radioactive matter routinely formed in the course of atomic power generation is considered. On-site handling of wastes and effluents, shipment of radioactive materials from the power plant, processing of spent fuel, and ultimate disposal of radioactive wastes are discussed. An appendix summarizes pertinent background information on radioactivity and radiation protection. (M.C.G.)

31623 MANAGEMENT OF RADIOACTIVE WASTES. Mawson, C. A. Van Nostrand Nuclear Science Series. Princeton, N. J., D. Van Nostrand Company, Inc., 1965. 203p. $6.95.

Information is included on general principles of waste management; sources and nature of radioactive wastes; waste management in the uranium industry; treatment of gaseous effluent; storage and fixation of liquid wastes; treatment of liquid wastes; processing of solid wastes; storage in geological formations; ground disposal; disposal into sea, lakes, and rivers; management of small quantities of radioactive waste; monitoring and control; and political and legal considerations. Information on atmospheric dispersion is appended. (P.C.H.)

GENERAL AND MISCELLANEOUS

31624 (BNL-8132) THE PLASMA DISAPPEARANCE OF RADIOACTIVE CYANOCOBALAMIN: EFFECT OF PRIOR ADMINISTRATION OF VITAMIN B_{12} ANALOGUES. L. M. Meyer, L. M. Schiffer, D. A. White, and E. P. Cronkite (South Nassau Communities Hospital, Oceanside, N. Y.; Brookhaven National Lab., Upton, N. Y.; Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). [1964]. Contract AT(30-2)-Gen-16. 21p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Following intravenous injection of labeled vitamin B_{12}, the disappearance of radioactivity from plasma of patients with chronic myelocytic leukemia is strikingly delayed when compared to normal subjects. It was demonstrated that intramuscular administration of 1,000 μg of non-radioactive cyanocobalamin 24 hours before the procedure converts the prolonged disappearance rate to a more normal pattern. Administration of hydroxocobalamin 24 hours prior to a ^{57}Co-cyanocobalamin tracer dose resulted in a rapid plasma disappearance of the ^{57}Co. This plasma blocking effect of hydroxocobalamin was greater than cyanocobalamin or any of the other vitamin B_{12} analogues tested. Only when hydroxocobalamin was the blocking agent was any of the subsequently administered ^{57}Co-cyanocobalamin dialyzable in the plasma or found in significant quantities in the urine. The implications of these findings with regard to B_{12} binding sites are discussed. (auth)

31625 (BNL-8203) EXPERIMENTAL AND DEVELOPMENTAL MORPHOGENESIS IN PINUS. I. THE ROLE OF THE COTYLEDONS AND ORIENTATION ON EMBRYO GROWTH IN VITRO. Graeme P. Berlyn and Jerome P. Miksche (Yale Univ., New Haven, Conn. School of Forestry and Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT(30-2)-Gen-16. 28p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A study was made of the role of the cotyledons, embryo orientation, surgical treatment, darkness, light, and coconut milk on the growth of Pinus lambertiana Dougl. embryos in vitro. The embryos did not require an haustorial function of the cotyledons in vitro. Autoradiographic evidence indicates that considerable absorption occurs through the cotyledons in vivo, but only because of their large absorptive surface. Removal of the shoot meristem drastically altered the developmental physiology of the embryo and the function of the root meristem was severely inhibited. Positional effects on embryo growth were reversed by darkness. Root anatomy was very sensitive to the culture environment. Coconut milk had no statistically demonstrable effect on embryo growth as measured by the analysis of variance and Student-Newman-Keuls' range test; however, the graphical analysis suggests that, in conjunction with the presence of the shoot meristem, there may be a slight beneficial response to coconut milk. (auth)

31626 (CALT-221-9) CONSTITUTION OF GOLD–GERMANIUM ALLOYS QUENCHED FROM THE MELT. T. R. Anantharaman, Huey-Lin Luo, and William Klement, Jr. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Apr. 1965. Contract AT(04-3)-221. 15p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Two new metastable intermediate phases were obtained in gold–germanium alloys by rapid cooling from the melt. One is of the hcp structure with near-ideal axial ratio and may be considered a Hume-Rothery phase. The other has a complex tetragonal structure and may be considered as a superlattice made up of 44 fcc unit cells. Alloys with the latter complex phase are characterized by marked preferred orientation. The metastable constitution of the Au–Ge alloys is discussed with reference to the rate of cooling from the melt. (auth)

31627 (COO-1198-192) ELECTRON-NUCLEAR DOUBLE RESONANCE STUDY OF Z_1-CENTERS IN POTASSIUM CHLORIDE. James Carr Bushnell (Illinois Univ., Urbana. Dept. of Physics and Illinois Univ., Urbana. Materials Research Lab.). July 1964. Contract AT(11-1)-1198. 102p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

The Z_1-center in potassium chloride, which is associated with the presence of divalent alkaline earth impurities, was investigated by the electron-nuclear double resonance (ENDOR) technique of Feher. Strontium and calcium were used as doping agents. Previous experimental and theoretical investigations of the structure of the Z_1-center have considered the models proposed by Seitz and by Pick. Seitz's model of the Z_1-center is a substitutional impurity which has trapped an electron, while Pick's model also includes a positive ion vacancy in the next-nearest neighbor position to the impurity ion. The results of the ENDOR measurements demonstrate that the Seitz and Pick models of the Z_1-center are not correct. Two structures, both present in crystals doped with either calcium or strontium, but in different relative concentrations, are proposed to explain the experimental results. Both structures contain a positive and negative ion vacancy complex and a divalent impurity, plus an electron trapped at the negative ion vacancy. Kleefstra has also concluded that this combination of defects constitutes the Z_1-center. In both proposed structures, the vacancy pair are nearest neighbors. In one structure, the divalent impurity is located at the fourth nearest neighbor position from the positive ion vacancy, giving a linear structure, while in the other the divalent impurity is a next-nearest neighbor to the positive ion vacancy. The largest hyperfine constants for calcium and strontium Z_1-centers, for corresponding sets of lines, differ by only about 1%, indicating that the effect of the divalent impurity is essentially due to its effective positive charge with respect to the lattice, with the detailed wave function in the vicinity of the impurity causing only a small effect. A search for resolved hyperfine interaction due to ^{87}Sr in a crystal doped with enriched strontium showed no resolved hyperfine interaction, which would have been expected if the model of Seitz or of Pick were correct. A preliminary search was made for ENDOR absorption due to Z_2-centers in strontium-doped KCl, but only lines attributable to the F-centers also present were found. Previous ESR studies of the Z_2-center are in direct conflict with each other. The present experiment, while not conclusive, suggests that the Z_2-center is diamagnetic, in agreement with the conclusion of Ohkura and Murase. (auth)

31628 (COO-1198-197) PHASE TRANSFORMATIONS IN BETA-CuGa ALLOYS. Toshio Saburi (Illinois Univ., Urbana. Dept. of Mining, Metallurgy, and Petroleum Engineering and Illinois Univ., Urbana. Materials Research Lab.). July 1964. Contract AT(11-1)-1198. 68p. Dep.(mn); $2.00(cy), 2(mn) CFSTI.

The martensitic and massive transformations in β–Cu–Ga alloys were investigated using optical and transmission electron micrographs and electron diffraction patterns. It was found that the martensitic and massive transformations do not occur in the same temperature range and that the massive transformation occurs through coherent nucleation and incoherent growth processes. (W.L.G.)

31629 (COO-1198-239) THERMAL CONDUCTIVITY OF HYDROXIDE-DOPED ALKALI HALIDES. M. V. Klein (Illinois Univ., Urbana. Dept. of Physics). [1964]. Contract AT(11-1)-1198. 10p. (CONF-650317-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Physical Society Meeting, Kansas City, Mo.

Anomalously low thermal conductivities of hydroxide-doped alkali metal halides at low temperatures were investigated for the following systems: NaCl–NaOH, KCl–KOH, KBr–KOH, NaBr–NaOH, and RbCl–RbOH. The effects of electric fields on the thermal conductivity of the KOH-doped KCl was studied. It is concluded that KCl–

KOH and NaCl–NaOH show anomalously large low-temperature depressions that demand unusual mechanisms. (D.L.C.)

31630 (CU-2663-22) RESPONSE OF DYE TRACERS TO SEA SURFACE CONDITIONS. B. Katz, R. Gerard, and M. Costin (Lamont Geological Observatory, Columbia Univ., Palisades, N. Y.). June 1965. Contract AT(30-1)-2663. 30p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Analysis of aerial photographs of a number of sea surface dye tracer experiments has revealed two features of the surface circulation: (1) a modified Ekman-type drift current, and (2) a system of helical current vortices having axes which are horizontal and nearly parallel to the wind. These data also indicate that there is a strong correlation between wind, sea state, and the development of a patch of dye. This suggests that such factors, rather than random eddies, may be of paramount importance to the spreading of a contaminant at the sea surface. (auth)

31631 (IDO-17074) FIELD EVALUATION AND CONTROL OF PERSONNEL BEHAVIOR. R. J. Nertney (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1965. Contract AT(10-1)-205. 29p. Dep.; $2.00(cy), 1(mn) CFSTI.

Considerations are presented for use in performing human factor studies in a relatively unperturbed working environment and certain specific programs with which we have had experience are outlined. In establishing the system, it was decided not to use individual employee worth criteria but rather to establish working group indices based on specific organizational objectives as stated by management. The ability of the organization to fulfill these objectives is sampled by staff evaluators on a did do or did not do basis. Reduction to simple dichotomy makes use of quality control techniques possible and provides useful numerical indices for purposes of evaluation and control of personnel behavior under field working conditions. (auth)

31632 (LF-25) EXPERIMENTAL INFECTION OF BEAGLES WITH ECHO VIRUS TYPE 6. Pindak, F. F.; Clapper, W. E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). May 1965. Contract AT(29-2)-1013. 15p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Live Echo-6 virus was administered orally to six beagles previously shown by culture to be free of this agent. Some symptoms suggesting enteric disease were observed in most of the dogs. The virus was isolated from the stools of four and the blood of one, but no neutralizing antibodies could be demonstrated. Repeated intramuscular injection of live virus in six dogs produced titres as high as 1:512 and a four-fold or greater rise in all. No signs of illness were observed in those given parenteral injections. (auth)

31633 (MRC-489(Pts.I&II)) IRON SINGLE CRYSTAL PREPARATION. PART I. THE PREPARATION OF THE CRYSTALS AND A STUDY OF THEIR MECHANICAL AND ELECTRICAL PROPERTIES AT LOW TEMPERATURES. PART II. SOME EXPERIMENTS ON THE USE OF THE ELECTROTRANSPORT PHENOMENON FOR THE FURTHER PURIFICATION OF ELECTRON-BEAM ZONE-REFINED IRON. Final Report, April 2, 1963–April 1, 1964. E. J. Hughes, P. W. Barton, and R. D. Vigue (Materials Research Corp., Orangeburg, N. Y.). Contract AT (30-1)-2980. 64p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

A strain anneal method for the preparation of single crystals from polycrystalline electron beam zone-refined iron is described. The tensile properties of crystals having orientations covering the whole stereographic triangle were studied at −196°C. The results obtained differed strongly from those obtained by earlier workers using less pure crystals in that ductility was observed in all orientations. Electrical resistance measurements made at room temperature and 4.2°K gave resistance ratio values for the crystals of between 200 and 300. An apparatus was constructed which allows heavy currents to be passed through a metal rod whilst it is maintained in a vacuum or inert atmosphere and its ends are kept near room temperature by water cooling. This apparatus was used to study the possibility of using the electrotransport phenomenon for the further purification of electron beam zone-refined iron. A series of iron specimens were prepared from a single rod of electron beam zone-refined iron which contained a total impurity content of about 50 ppm. A direct current of 70 amps was passed through each of three of the specimens for a period of 72 hours. During this period the specimen was maintained in an atmosphere of pure hydrogen and, as a result of Joule heating, its midpoint was at a temperature of about 1300°C. Similar experiments were carried out on two further specimens using alternating instead of direct current. The impurity distribution along the lengths of each of these five specimens was examined by making resistance ratio measurements. By comparing the results from the D.C. and A.C. experiments it was possible to separate out effects due to the Soret effect from those due to electrotransport. In this way it was found that in the D. C. experiments electrotransport had caused a measurable movement of impurities away from the anode. This effect was, however, small compared to the Soret diffusion which accompanied it. These results are therefore discouraging from the point of view of developing a purification technique. The behavior of the impurity distributions in the five rods on annealing was studied by repeating the resistance ratio measurements after successive 2 hour vacuum annealing treatments at 200, 350, 450, and 650°C. Annealing at 200°C produced an overall increase in the resistance ratios and this was not significantly altered by the 350 and 450°C anneals. The 650°C anneal, however, produced an overall decrease in the resistance ratios of about the same magnitude. (auth)

31634 (NYO-3029-2) SOME COMMENTS ON ACID-SAW TECHNIQUES. Report No. 295. R. H. Geiss, W. G. Lehmann, M. Meistrich, R. W. Rollins, and J. Silcox (Cornell Univ., Ithaca, N. Y. Materials Science Center). Dec. 11, 1964. Contract AT(30-1)-3029. 17p. (NYO-3087-2). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Acid sawing provides a means of cutting single crystals without substantial deformation. The saw designed by Young and Wilson, was modified for improved operation. The cut surfaces of a sawed Ni bar are illustrated. (D.L.C.)

31635 (ORNL-TM-1162) CONTAINMENT CRITERIA FOR LABORATORIES HANDLING INFECTIOUS AGENTS. R. C. Allen, N. E. Bolton, T. A. Lincoln, and A. C. Upton (Oak Ridge National Lab., Tenn.). May 1965. Contract W-7405-eng-26. 21p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Containment criteria are presented to assure safety within laboratories handling infectious agents. Also included is the classification used for establishing the relative hazard of any given virus or biologic agent, the duties of responsible investigators, and the responsibilities of the Biohazards Committee. The containment criteria specified herein have been established to assure safety in laboratories engaged in biological research. Separate containment criteria were established for the zonal centrifuge program in which large quantities of viral or virus-like agents are concentrated in a small volume, making any accident or mistake in technique of greater consequence than under usual laboratory conditions. Infectious agents are classified as to hazards associated with handling under routine laboratory conditions. (C.H.)

31636 (PNE-400) PROJECT CHARIOT—ENVIRONMENTAL PROGRAM. Preliminary Report. (Public Health Service, Anchorage, Alaska. Arctic Health Research Center). Nov. 23, 1959. Contract SF-54-373. 74p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Results of ornithological investigations in the Cape Thompson region are reported; species composition, ecological distribution, density, productivity, and seasonal movements are discussed. The present knowledge of marine mammals in this region is given, and results of field work in 1959 are given. Identifications of algae and plankton in the phycological investigations are discussed. (D.L.C.)

31637 (PNE-401) PROJECT CHARIOT — ENVIRONMENTAL PROGRAM. Interim Final Report. (Public Health Service, Anchorage, Alaska. Arctic Health Research Center). June 1, 1960. Contract SF-54-373. 30p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Some of the observations from the 1959 field season on the density and seasonal movements of nonbreeding birds and on winter birds in the Cape Thompson region are given. Field work on marine mammals are described, and the present state of information on these mammals is summarized. Phycological investigations are reported briefly, and algae and plankton species which were identified are listed. (D.L.C.)

31638 (PNE-404) PHYCOLOGICAL INVESTIGATIONS IN THE CAPE THOMPSON REGION. (Public Health Service, Anchorage, Alaska. Arctic Health Research Center). [Dec. 1960]. Contract SF-54-373. 70p. Dep.(mn); $3.00 (cy), 2(mn) CFSTI.

Results are reported from productivity studies on plankton of a freshwater lake and two brackish lagoons in the Cape Thompson region of northwestern Alaska. The ^{14}C technique was used in productivity measurements and results of studies of the numbers and species of plankton were correlated with the ^{14}C data. Chemical and physical data complementary to these studies were obtained. A list is included of diatoms from Cape Thompson and environs that includes 383 species representing 43 genera. (C.H.)

31639 (PNE-405) PROJECT CHARIOT — ENVIRONMENTAL PROGRAM. Interim Final Report. (Public Health Service, Anchorage, Alaska. Arctic Health Research Center). June 1, 1961. Contract SF-54-373. 15p. Dep. (mn); $1.00(cy), 1(mn) CFSTI.

A brief description is given of the work carried out on birds, marine mammals, phytoplankton, and zooplankton in the Cape Thompson region. Species identifications are given. (D.L.C.)

31640 (SC-DC-65-1391) UPDATING A COMPUTER AIR-CONDITIONING SYSTEM. H. H. Baxter, Jr. (Sandia Corp., Albuquerque, N. Mex.). [Apr. 1965]. Contract [AT(29-1)-789]. 27p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Problems associated with updating an air conditioning system, orginally installed to cool tube-type computers, to accomodate solid-state computer facilities are outlined. Problems involved in continuity of computer operation during the air-conditioning changeover are also noted. (T.F.H.)

31641 (SC-RR-65-57) DETACHED LEVER ESCAPEMENT STUDY. Shinkle, J. N. (Sandia Corp., Albuquerque, N. Mex.). May 1965. Contract AT(29-1)-789. 41p. Dep. (mn); $2.00(cy), 1(mn) CFSTI.

Presented are the analyses and the experimental findings of a detached lever escapement study. Various modifications of the basic escapement which increased its torque regulation capacity are also described. Specifically, analytical and experimental analyses are presented for the effects of escape wheel inertia, balance wheel braking action, balance wheel windage, beat rate changes, hairspring side thrust, and certain aspects of geometry. (auth)

31642 (SC-TM-64-963) CLEANING METHODS FOR SEMICONDUCTOR AND THIN-FILM TECHNOLOGY. J. D. Williams and J. N. Shafer (Sandia Corp., Albuquerque, N. Mex.). Aug. 1964. Contract AT(29-1)-789. 29p. Dep. (mn); $2.00(cy), 1(mn) CFSTI.

The various ways in which materials used in the fabrication of semiconductor and thin-film devices may become contaminated are presented. Procedures of removing and detecting this contamination are reviewed. By the use of the indium test of surface cleanliness (G. L. Krieger and G. J. Wilson, 1413-2, SC-TM-276-63(14)), various cleaning procedures which all yielded the highest indication of cleanliness by the steam and water break tests, could be differentiated. (auth)

31643 (SC-TM-65-3) THE RECONSTRUCTION OF AN ANALOG SIGNAL FROM NONUNIFORMLY SPACED SAMPLES. Honnold, G. H. (Sandia Corp., Albuquerque, N. Mex.). Feb. 1965. Contract AT(29-1)-789. 36p. Dep. (mn); $2.00(cy), 1(mn) CFSTI.

The instrumentation of long-duration signals can lead to a desire to reduce the number of samples required for signal representation. The number of samples resulting from a sampling operation can be reduced by making either the sampling scheme itself or some process subsequent to a fixed-frequency sampling of the signal dependent upon some characteristic of the signal. In general, the samples which result from such sampling processes will be nonuniformly spaced in time. The nature of these sampling schemes is discussed, as are several techniques for the reconstruction of an analog signal from a set of nonuniformly spaced samples. The results do not lead to generalizations about the choice of sampling and reconstruction schemes, but some insight into the problems involved and the nature of the sampling and reconstruction processes are provided. (auth)

31644 (TID-3729) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period, April–May 1965. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 18p. Dep.; Free (DTIExtension)

A total of 91 unclassified bibliographies is listed. Report number, subject, and author indexes are included. (D.L.C.)

31645 (TID-5001(5th Rev.)) SUBJECT HEADINGS USED BY THE USAEC DIVISION OF TECHNICAL INFORMATION. Robert E. Upchurch, ed. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). July 1965. 272p. Dep.; $6.00(cy), 5(mn) CFSTI.

A list is given of all subject headings and associated cross references used in the preparation of subject indexes for Nuclear Science Abstracts. Geographic subject headings, lists of elements, isotope synonyms, and uranium deposit classifications are also included. (D.L.C.)

31646 (TID-20866) CHRONOPOTENTIOMETRY IN FUSED NITRATES. PART 1. SILVER NITRATE–SODIUM NITRATE. Kazutaka Kawamura (Princeton Univ., N. Y.). [1963]. Contract AT(30-1)-2644. 15p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Chronopotentiometric measurements were carried out in molten $NaNO_3$–$AgNO_3$ to determine the friction coefficient r_{12} (1 = Ag, 2 = Na) from diffusion data. The diffusion coefficient of Ag ions was found to be 2.01, 2.25, and $2.46 \pm 0.05 \times 10^{-5}$ cm^2/sec at 315, 340, and 360°C, respectively, and the activation energy was calculated to be 3.24 ± 0.06 kcal/mole. The following r_{12} values were calculated: 0.78, 0.85, and $0.88 \pm 0.12 \times 10^{-6}$ joule-sec/cm-mole at 315, 340, and 360°C, respectively. The temperature dependence of r_{12} is discussed briefly. (D.L.C.)

31647 (TID-21807) OPTICAL RECTIFICATION (thesis). Michael Bass (Michigan Univ., Ann Arbor). 1964. Contract AT(11-1)-1112. 94p. Dep.(mn); $3.00 (cy), 2(mn) CFSTI.

An experimental and theoretical study of optical rectification is reported. Optical rectification, or the dc effect, refers to the development of a time independent or dc polarization which accompanies the passage of an intense beam of light through certain crystals. This polarization has magnitude proportional to the intensity of the optical radiation, and can only occur in those crystals which lack a center of inversion. The theory of this effect is reviewed with particular emphasis on the predicted relation between optical rectification and the linear electro-optic effect. In order to observe optical rectification, light beams of extraordinarily high intensities are required. A one megawatt beam from a ruby laser was used to explore the effect in crystals of KDP (potassium dihydrogen phosphate), deuterated KDP, CdS, $Cd(S_{0.75} + Se_{0.25})$ and ZnTe. The detection procedure entailed mounting the crystal as the dielectric in a parallel plate capacitor and measuring the voltage induced by the dc polarization. The coefficient giving the dc polarization of

KDP parallel to its optic axis, X^3_{36}, was found to be 5×10^{-9} esu. This absolute value is uncertain to within a factor of three due to uncertainty in measuring the laser light intensity absolutely. Measured relative to KDP, the coefficient X^3_{36} for deuterated KDP was 2.1, X^3_{31} for CdS was 9, X^3_{31} for $Cd(S_{0.75} + Se_{0.25})$ was 29, and X^3_{36} for ZnTe was 73. These relative measurements, being independent of the light intensity, are estimated to be correct to within 50%. The relationship between optical rectification and the linear electro-optic effect was experimentally verified in KDP and deuterated KDP. Available linear electro-optic data for these crystals predict values for their dc coefficients in good agreement with the measured results. The temperature dependence of the dc effect in these crystals was observed to be identical with that of the linear electro-optic effect in the range from 120°K to 300°K. The quantum mechanical treatment predicts qualitatively that optical rectification should be enhanced in crystals which display optical absorption at frequencies near the laser frequency. This prediction was experimentally verified by the present studies of CdS, $Cd(S_{0.75} + Se_{0.25})$ and ZnTe. These three crystals have optical absorptions much nearer the ruby laser frequency than does KDP, and exhibit correspondingly larger optical rectification coefficients. An attempt to study the dependence of optical rectification in a given crystal on the laser frequency was made by exploring the effect in ZnTe using both neodymium and ruby lasers. A relative measurement, being more accurate, was to have been made using KDP as a reference. However, using the neodymium laser, a very large interfering signal was observed in KDP. Arguments are presented which show that this interfering signal was very likely due to a tertiary pyroelectric effect in the crystal stimulated by absorption of some of the laser beam energy. (auth)

31648 (TID-21857) A STUDY OF THE BIOSYNTHESIS OF TERTHIENYL. S. M. de Paul Palaszek (Michigan State Univ., East Lansing). [1964]. Contract AT(11-1)-698. 23p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A study was made of the biosynthetic pathway of 2,2′;5′, 2″-terthienyl in Tagetes erecta L. roots. Sodium sulfate-^{35}S, D-glucose-UL-^{14}C, DL-ornithine-2-^{14}C, and malonate-2-^{14}C were used. The experimental dilution factors are discussed; they indicate that the tricarboxylic acid cycle is not involved in the biosynthesis. (D.L.C.)

31649 (TID-21866) THE DETERMINATION OF THE IONIZATION CONSTANTS OF SOME SULFONIC ACIDS BY RAMAN MEASUREMENTS. O. D. Bonner and Arnold L. Torres (South Carolina Univ., Columbia. Dept. of Chemistry). [1962]. Contract AT(40-1)-1437. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The degree of ionization of p-toluenesulfonic acid and 2,5-dimethylbenzenesulfonic acid in aqueous solutions was determined by comparison of the relative intensities of the Raman lines arising from the C-H stretching in the CH_3 group and the S-O stretching in the SO_3^- ion for each molecule. These data were combined with activity coefficient data to yield ionization constants of 11.6 ± 0.3 and 2.7 ± 0.3 for the two acids. A comparison of the infrared spectra for samples of an ion exchanger film indicates a degree of ionization comparable to that of the two "model" compounds. (auth)

31650 (UCRL-7186-T(Rev.1)) PLANE STRESS PROBLEMS IN THE MATHEMATICAL THEORY OF ELASTICITY (thesis). Maurice Zaslawsky (Lawrence Radiation Lab., Univ. of California, Livermore). Feb. 1965. Contract W-7405-eng-48. 93p. Dep.; $3.00(cy), 2(mn) CFSTI.

Several mathematical methods for solving plane stress problems in elasticity are described. The power series and the Cauchy integral methods are discussed in detail, and the Fourier transform and finite difference methods are discussed. The power series method is applied to the solution for a rotating octagonal disk, and the equations which are necessary to determine the stress at any point on the octagon are presented. (L.B.S.)

31651 (UCRL-7860) FIRE-RETARDANT COATINGS. James R. Gaskill (Lawrence Radiation Lab., Univ. of California, Livermore). May 19, 1964. Contract W-7405-eng-48. 22p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Twenty-three strippable coating systems were tested for fire retardancy, scrubbability flexibility, chemical resistance, strippability, and toxicity. These systems were mechanically strippable, enamel-intumescent systems, chemically strippable or specialized cleanable coatings, and aluminum-silicon formulations. (D.L.C.)

31652 (UCRL-7910) SOLID-STATE REACTION KINETICS BY NON-ISOTHERMAL METHODS. I. THERMOGRAVIMETRIC AND DIFFERENTIAL THERMAL ANALYSIS STUDIES OF THE THERMAL DISSOCIATION OF POLYHALITE. T. D. George, W. W. Wendlandt, and M. W. Nathans (Lawrence Radiation Lab., Univ. of California, Livermore). June 10, 1964. Contract W-7405-eng-48. 23p. Dep.(mn): $1.00(cy), 1(mn) CFSTI.

The kinetic parameters, energy of activation, and reaction order of the thermal dissociation of polyhalite were investigated by non-isothermal thermogravimetric and differential thermal analysis methods. Simultaneous TGA-DTA was used to study the experimental factors which influence the kinetic results. It was found that under identical experimental conditions, DTA curves evaluated by the method of Borchardt and Daniels gave somewhat higher values of E* than those calculated from TGA data. It was also found that the particle size of the polyhalite used affected the energy of activation for the dissociation reaction. (auth)

31653 (UCRL-12342-T(Rev.)) A MULTIPURPOSE THEOREM PROVING HEURISTIC PROGRAM THAT LEARNS. James R. Slagle (Lawrence Radiation Lab., Univ. of California, Livermore). Jan. 1965. Contract W-7405-eng-48. 6p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Several unique features are introduced into computer programming, in general, and into automatic theorem proving, in particular. The heuristic program searches for a constructive proof or disproof of a given proposition. The search procedure efficiently selects the seemingly best proposition to work on next. This program is multipurpose in that the domains it can handle are varied. Finally, the program improves its search procedure with experience and thus learns to handle more difficult problems. (auth)

31654 (UCRL-12439-T) THE DEVELOPMENT OF PLASTIC-BONDED EXPLOSIVES. Edward James (Lawrence Radiation Lab., Univ. of California, Livermore). Apr. 29, 1965. Contract W-7405-eng-48. 15p. (CONF-650516-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Ordnance Assn., Propellants and Explosives Section, Yorktown, Va.

The development of a PBX is based on formulating principles embodying considerations of performance, handling and operational sensitivity, chemical and thermal stability, physical or mechanical properties and manufacturing. The history of the development of several important PBXs, 9007, 9407, 9010, 9404, and LX-04-1, is presented along with a discussion of the formulating considerations used to arrive at the final composition. Comparative properties are presented along with suggestions of application in different ordnance items. PBX 9404 is an example of an explosive in which energy density is maximized and so is highly brisant; PBX 9407 is very sensitive to shock initiation and so is important for booster applications. (auth)

31655 (JPRS-30087) TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 179. [1964]. 105p. (TT-65-30994). $4.00(CFSTI).

A total of 13 selected articles is presented. The topics treated by these articles are physics progress, scientific meetings, germanium extraction, use of organic reagents in polarography of inorganic substances, detection of Th and Zr, opial inequality, γ-spectral analysis of Th and U, nuclear detectors, medical and health personnel, agricul-

tural science, domestication of oil melon, botanists, and environmental tests of electronic equipment. Separate abstracts were prepared for the two articles dealing with the detection of Th and Zr and the γ-spectral analysis of Th and U. (D.L.C.)

For abstracts of individual papers see: 30088 and 30089.

31656 POWER DEVELOPMENT IN EUROPE, 1962–1967. J. Smuts. Elektroteknikeren, 60: 465(Oct. 11, 1964). (In Danish)

Power generating equipment to be installed in European countries between 1962 and 1967 is described. The total will be 57 Gw, 55% of this in units of over 200 Mw. In 1967, 90% of the installed equipment will be of over 200 Mw per unit. Details of plans for nuclear power stations in Britain, France, Italy, and the whole of Western Europe are given. Water power installations are also considered. (UKAEA)

31657 ROTARY CONTACT. John A. Masters and William M. Cooper (to U.S. Atomic Energy Commission). U.S. Patent 3,189,861. June 15, 1965.

A rotary contact or switch device in which two mating rotatable plastic bodies are provided with sealed communicating annular channels containing an electrically-conductive fluid, e.g., mercury is described. Terminals disposed on the bodies and communicating with mercury provide means for coupling the rotary contact into a circuit to provide a low-noise high-insulated connection even during rotation. (AEC)

31658 LIGHT SENSITIVE ALARM SYSTEM. Richard G. Cowen (to U. S. Atomic Energy Commission). U. S. Patent 3,191,048. June 22, 1965.

A highly sensitive photocell bridge circuitry that is stable against variations in temperature, voltage, and light fluctuations, while still providing an alarm in response to the presence of an intruder or smoke is described. The circuitry provides for battery operation, auxiliary power supplies, and fault detection relays and is capable of operation with a periodic light source as a battery conservation feature. As applied to protection of enclosed areas, the device uses pairs of photoresistors at various locations and connects the members of any one pair in diagonally opposite legs of the bridge circuit. (AEC)

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This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is identifiable by the absence of a report number.

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly. Cross references appear in the index cumulations. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

Specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Whenever it appears that such information would be useful, descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract. Such phrases are written so that the idea considered most important is presented first. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

For entries concerned with physics, if the modifier does not indicate whether the reference is experimental or theoretical, a symbol E or T or E/T is given.

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CONF-650418–		("BUILD" Conference on Direct Energy Conversion, Urbana, Apr. 1–2, 1965)
1	19-30978	See LA-DC-7073
CONF-650429–		(American Power Conference, Chicago, Apr. 27–29, 1965)
3	19-31572	ORINS
4	19-31573	ORINS
6	19-31569	ORINS
7	19-31570	ORINS
9	19-31571	ORINS
CONF-650431–		(Association of Iron and Steel Engineers, Rolling Mill Conference, Birmingham, Ala., Apr. 26–28, 1965)
1	19-30692	See NLCO-923
CONF-650501–		(The Application of Computing Methods to Reactor Problems, Argonne, Ill., May 17–19, 1965)
6	19-31513	Dep.(mn); $1.00(cy), 1(mn) CFSTI
7	19-31467	See LA-DC-7007
8	19-31505	See LA-DC-5663
9	19-31423	See LA-DC-6756
CONF-650504–		(IAEA Symposium on Pulsed Neutron Methods, Karlsruhe, Germany, May 10–14, 1965)
4	19-31195	See ORNL-P-1167
5	19-31196	See RPI-328-35(p.1-34)
8	19-31607	See LA-DC-6786
CONF-650510–		(Purdue Conference on Instrumentation for High Energy Physics, Lafayette, Indiana, May 11–15, 1965)
2	19-30532	See UCRL-11999
3	19-30533	See UCRL-16087
CONF-650515–		(International Conference and Exhibition of the Canadian Nuclear Assocn., Quebec, Canada, May 9–12, 1965)
1	19-31183	See AECL-2212
CONF-650516–		(American Ordnance Assocn., Propellants and Explosives Section, Yorktown, Va., May 11–12, 1965)
1	19-31654	See UCRL-12439-T
CONF-650521–		(Conference on Purification of Materials, New York, May 6–8, 1965)
1	19-30083	See ORNL-P-1237

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CONF-650525–	**(International Conference on the Internal Conversion Process, Nashville, Tenn., May 10–13, 1965)**	
1	19-30522	See IS-1159
CONF-650602–	**(American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn., June 20–24, 1965)**	
20	19-31595	See LA-DC-7017
22	19-31534	See BNL-9007
CONF-650604–	**(International Symposium on Working Methods in High Activity Hot Labs., Grenoble, France, June 15–18, 1965)**	
4	19-30435	See AECL-2233
CONF-650610–	**(American Institute of Aeronautics and Astronautics, Propulsion Joint Specialists Conference, Colorado Springs, Colo., June 14–18, 1965)**	
1	19-31594	See LA-DC-6842
CONF-650613–	**(American Chemical Society, 20th Northwest Regional Meeting, Corvallis, Oregon, June 14, 1965)**	
1	19-30084	See RL-SA-33
CONF-650614–	**(Symposium on the use of Isotopes and Radiation in Soil-Plant Nutrition, Ankara, June 28–July 2, 1965)**	
1	19-29852	Dep.(mn); $1.00(cy), 1(mn) CFSTI
CONF-650615–	**(IAEA Panel on Utilization of Thorium in Power Reactors, Vienna, June 14–18, 1965)**	
1	19-31520	See ORNL-TM-1141
CONF-650704–	**(IAEA Symposium on Thermodynamics, Vienna, July 22–27, 1965)**	
1	19-30147	See BNL-9167
COO–		
32-107	19-30260	J. Am. Chem. Soc., 87: 2494-5(1965)
651-12	19-31535	Dep.(mn); $2.00(cy), 2(mn) CFSTI
770-11	19-30319	Dep.(mn); $1.00(cy), 1(mn) CFSTI
881-43	19-31003	Dep.(mn); $1.00(cy), 1(mn) CFSTI; Gmelin, AED-CONF-64-249-1 Phys. Rev., 138: B652-5(1965)
881-48	19-31059	Nuovo Cimento (10), 37: 1795-6(1965)
1198-192	19-31627	Dep.(mn); $4.00(cy), 2(mn) CFSTI
1198-197	19-31628	Dep.(mn); $2.00(cy), 2(mn) CFSTI
1198-239	19-31629	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1319-24	19-30667	Dep.(mn); $2.00(cy), 1(mn) CFSTI
CRC–	**(Canadian)**	
1219	19-30228	Dep.; $0.50(AECL)
CRCE–	**(Canadian)**	
1189	19-31463	Dep.; $1.50(AECL)
CRT–	**(Canadian)**	
1218	19-31187	Dep.; $0.50(AECL)
CU–	**(Misc.)**	
1932-240	19-31004	Dep.(mn); $1.00(cy), 1(mn) CFSTI
2663-22	19-31630	Dep.(mn); 2.00(cy), 1(mn) CFSTI
CVNA–	**(Misc.)**	
232	19-31536	Dep.(mn); $2.00(cy), 1(mn) CFSTI
DP–		
849	19-30320	Dep.; $1.00(cy), 1(mn) CFSTI
DSSC-S–	**(Non-AEC)**	
597	19-29885	See AD-611359
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EAC–		
5	19-31334	See TID-21872
EANDC(E)–	**(European-American Nuclear Data Committee)**	
58(U)	19-31188	Dep.(mn)
ECOM–	**(Non-AEC)**	
2547	19-30977	
EE–	**(Misc.)**	
38	19-31337	See USCEC-82-218
EGG–		
1183-1130	19-31477	Dep.(mn); $1.00(cy), 1(mn) CFSTI
EUR–	**(European Atomic Energy Community)**	
876.d	19-31430	Nukleonik, 6: 271-4(1964)
1023.e	19-31210	J. Nucl. Energy, Pt. A and B, 18: 665-701(1964)
1360.es	19-30128	Rev. Univ. Ind. Santander, 5: 493-6(1963)
1819.e	19-30074	Dep.(mn)
2075	19-30668	See EURAEC-1274
2201.f	19-29896	Dep.(mn)
2218.e	19-29897	Dep.(mn)
2226.f	19-30401	See CEA-R-2738
EURAEC–		
1150	19-30535	See WCAP-2644
1262	19-30371	See GEAP-4721
1274	19-30668	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1278	19-30536	See WCAP-2666
1312	19-31519	See GEAP-3771-15
1315	19-31190	See GEAP-4782
1368	19-31521	See WCAP-3385-3
FR–	**(Non-AEC)**	
64-10-317	19-30874	See AD-609057
FTD-TT–	**(Non-AEC)**	
64-966	19-30699	See AD-611421
64-1297	19-30754	CFSTI
GA–	**(Misc.)**	
4569	19-31537	Dep.(mn); $3.00(cy), 2(mn) CFSTI
4937	19-31538	Dep.(mn); $2.00(cy), 2(mn) CFSTI
5033	19-30736	Dep.; $4.00(cy), 2(mn) CFSTI
5416	19-31391	Phys. Fluids, 8: 1197-9(1965)
5861	19-30939	See AD-609168
6008	19-30595	
6026	19-31189	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6294	19-31573	See CONF-650429-4
GAMD–	**(Misc.)**	
4737	19-31539	Dep.(mn); $2.00(cy), 1(mn) CFSTI
5278	19-31540	Dep.(mn); $1.00(cy), 1(mn) CFSTI
5411	19-31501	Dep.(mn); $5.00(cy), 5(mn) CFSTI
GAT-R–		
359	19-30438	Dep.(mn); $3.00(cy), 2(mn) CFSTI
GEAP–	**(Misc.)**	
3771-15	19-31519	Dep.(mn); $4.00(cy), 2(mn) CFSTI
4721	19-30371	Dep.(mn); $2.00(cy), 1(mn) CFSTI
4767	19-31541	Dep.(mn); $1.00(cy), 1(mn) CFSTI
4782	19-31190	Dep.(mn); $1.00(cy), 1(mn) CFSTI
GEMP–	**(Misc.)**	
46A	19-30646	Dep.; $2.00(cy), 1(mn) CFSTI
190F	19-31592	
328	19-31593	Dep.(mn); $3.00(cy), 2(mn) CFSTI
356	19-30823	Dep.; $3.00(cy), 2(mn) CFSTI
HN–		
180	19-31604	Dep.; $6.75(cy), 11(mn) CFSTI
HPR–	**(Norwegian)**	
47	19-31583	Dep.(mn)
59	19-31542	Dep.(mn)
HW–		
51911	19-30689	Dep.(mn); $1.00(cy), 1(mn) CFSTI
72219	19-31543	Dep.; $3.00(cy), 2(mn) CFSTI
74640	19-30973	Dep.(mn); $1.00(cy), 1(mn) CFSTI
80723	19-30393	Dep.(mn); $1.00(cy), 1(mn) CFSTI
81460	19-30974	Dep.(mn); $1.00(cy), 1(mn) CFSTI
84330(Rev.1)	19-31585	Dep.(mn); $2.00(cy), 1(mn) CFSTI
84573	19-30647	Dep.; $5.00(CFSTI)

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84575	19-31605	Dep.(mn); $2.00(cy), 2(mn) CFSTI
84614	19-31606	Dep.(mn); $1.00(cy), 1(mn) CFSTI
HW-SA–		
3496	19-30394	Mater. Evaluation, 23: 279-84(1965)
3627	19-29898	Dep.(mn); $1.00(cy), 1(mn) CFSTI
3629	19-30824	Dep.(mn); $1.00(cy), 1(mn) CFSTI
3632	19-30372	Dep.(mn); $1.00(cy), 1(mn) CFSTI
IA–	**(Non-AEC)**	
715	19-29853	Dep.(mn)
IC–	**(Misc.)**	
65/30	19-30911	Dep.(mn)
65/45	19-31005	Dep.(mn)
65/46	19-31006	Dep.(mn)
65/50	19-31007	Dep.(mn)
IDO–		
17017	19-30520	Dep.; $5.00(cy), 3(mn) CFSTI
17042	19-31464	Dep.; $3.00(cy), 2(mn) CFSTI
17074	19-31631	Dep.; $2.00(cy), 1(mn) CFSTI
28631	19-31544	Dep.; $4.00(cy), 3(mn) CFSTI
IFA-CD–	**(Rumanian)**	
29	19-30300	Dep.(mn)
INR–	**(Polish)**	
470/IX-A	19-31502	Dep.
564/IX-A	19-31191	Dep.
572/IX-A	19-31503	Dep.
587/II	19-30484	Dep.
592/11/PL	19-30521	Dep.
INSJ–	**(Japanese)**	
83	19-30969	Dep.(mn)
IPP–	**(Non-AEC)**	
1/33	19-31326	Dep.(mn)
1/34	19-31327	Dep.(mn)
6/32	19-31326	See IPP-1/33
IS–		
792	19-30770	J. Am. Ceram. Soc., 48: 227-33(1965)
1032	19-31218	Dep.; $4.00(cy), 3(mn) CFSTI
1071	19-31219	Dep.; $5.00(cy), 3(mn) CFSTI
1153	19-30321	Dep.(mn); $3.00(cy), 2(mn) CFSTI
1159	19-30522	Dep.(mn); $1.00(cy), 1(mn) CFSTI
IS-Trans–		
14	19-31450	Dep.(mn); $1.00(cy), 1(mn) CFSTI; $1.10(fs), $0.80(mf) JCL
15	19-30087	Dep.(mn); $2.60(fs), $0.86(mf) JCL
ISS–	**(Italian)**	
64/43	19-30485	Dep.(mn)
64/44	19-30486	Dep.(mn)
JAERI–	**(Japanese)**	
1077	19-31328	Dep.(mn)
4031	19-30229	Dep.(mn)
JINR–	**(Russian)**	
P-1997	19-30523	Dep.(mn)
P-2031	19-31220	Dep.(mn)
P-2069	19-29899	Dep.(mn)
JPRS–	**(Non-AEC)**	
29112	19-29833	$2.00(CFSTI)
29270	19-30851	$4.00(CFSTI)
29411	19-29834	$1.00(CFSTI)
29904	19-29906	$1.00(CFSTI)
29912	19-29835	$2.00(CFSTI)
30087	19-31655	$4.00(CFSTI)
30161	19-29907	$1.00(CFSTI)
KAPL–		
3080	19-31192	Dep.(mn); $2.00(cy), 1(mn) CFSTI
3085	19-31221	Dep.(mn); $2.00(cy), 1(mn) CFSTI
3089	19-30738	Dep.(mn); $1.00(cy), 1(mn) CFSTI

Report No.	Abstract No.	Availability
3093	19-31466	Dep.(mn); $2.00(cy), 1(mn) CFSTI
LA–		
3164	19-30148	Dep.; $5.00(cy), 3(mn) CFSTI
3171	19-31008	Dep.; $2.00(cy), 1(mn) CFSTI
3221	19-31504	Dep.; $3.00(cy), 2(mn) CFSTI
3259	19-31445	Dep.; $4.00(cy), 2(mn) CFSTI
3266	19-31222	Dep.; $3.00(cy), 2(mn) CFSTI
3268	19-30942	Dep.; $3.00(cy), 2(mn) CFSTI
3270	19-31223	Dep.; $3.00(cy), 2(mn) CFSTI
3291	19-30065	Dep.; $1.00(cy), 1(mn) CFSTI
3294	19-31329	Dep.; $3.00(cy), 1(mn) CFSTI
LA-DC–		
5155	19-31310	p.769-804 of "Alpha-, Beta- and Gamma-Ray Spectroscopy." Amsterdam, North-Holland Publishing Co., 1965.
5663	19-31505	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6555	19-29867	Health Phys., 11: 623-8(1965)
6756	19-31423	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6786	19-31607	Dep.(mn); $2.00(cy), 1(mn) CFSTI
6792	19-31387	Phys. Fluids, 8: 1168-75(1965)
6842	19-31594	Dep.(mn); $1.00(cy), 1(mn) CFSTI
7007	19-31467	Dep.(mn); $2.00(cy), 1(mn) CFSTI
7017	19-31595	Dep.(mn); $1.00(cy), 1(mn) CFSTI
7026	19-31169	Dep.(mn); $3.00(cy), 2(mn) CFSTI
7073	19-30978	Dep.(mn); $1.00(cy), 1(mn) CFSTI
LADC–		
6484	19-30639	Dep.(mn); $1.00(cy), 1(mn) CFSTI
LAL–	**(French)**	
1133	19-31224	Dep.(mn)
LF–		
25	19-31632	Dep.(mn); $1.00(cy), 1(mn) CFSTI
MATT–		
304	19-31385	Phys. Fluids, 8: 1146-54(1965)
308	19-31386	Phys. Fluids, 8: 1161-7(1965)
329	19-30230	Dep.(mn); $1.00(cy), 1(mn) CFSTI
MCW–		
1491	19-30739	Dep.; $2.00(cy), 1(mn) CFSTI
MIT–	**(Misc.)**	
334-12	19-30231	Dep.; $2.00(cy), 1(mn) CFSTI
2241-3	19-30842	Dep.(mn); $3.00(cy), 2(mn) CFSTI
2241-4	19-31133	Dep.(mn); $5.00(cy), 3(mn) CFSTI
ML-TDR–	**(Non-AEC)**	
64-270	19-30690	$5.00(CFSTI)
64-312	19-30686	See AD-608945
MLM–		
1238	19-30629	Dep.; $2.00(cy), 1(mn) CFSTI
1241	19-30439	Dep.; $1.00(cy), 1(mn) CFSTI
1245	19-30630	Dep.(mn); $2.00(cy), 1(mn) CFSTI
MND–	**(Misc.)**	
2706-13	19-31545	Dep.(mn); $6.00(cy), 5(mn) CFSTI
3137	19-30631	Dep.(mn); $6.00(cy), 5(mn) CFSTI
3169-18	19-30621	Dep.(mn); $2.00(cy), 2(mn) CFSTI
3169-21	19-30622	Dep.(mn); $2.00(cy), 1(mn) CFSTI
3169-47	19-31596	Dep.(mn); $2.00(cy), 1(mn) CFSTI
3169-60	19-30623	Dep.(mn); $3.00(cy), 2(mn) CFSTI
3169-61	19-30624	Dep.(mn); $4.00(cy), 4(mn) CFSTI
3386	19-31546	Dep.(mn); $2.00(cy), 1(mn) CFSTI
MND-P–		
2356	19-30625	Dep.(mn); $4.00(cy), 2(mn) CFSTI
MPI-PAE–	**(German)**	
P1-3/65	19-31330	Dep.(mn)
MRC–	**(Misc.)**	
489(Pts.I&II)	19-31633	Dep.(mn); $3.00(cy), 2(mn) CFSTI
MSAR–	**(Misc.)**	
65-58	19-30079	Dep.(mn); $1.00(cy), 1(mn) CFSTI

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N–	**(Misc.)**	
64-20594	19-30943	$7.60(CFSTI)
64-28460	19-30691	$3.60(CFSTI)
65-19502	19-30397	See NASA-CR-54240
NAA-SR–		
9600(Vol.III)	19-30080	Dep.; $2.00(cy), 1(mn) CFSTI
11129	19-31597	Dep.; $2.00(cy), 1(mn) CFSTI
NAA-SR-Memo–		
4967	19-31547	Dep.(mn); $2.00(cy), 1(mn) CFSTI
9524	19-30373	Dep.(mn); $2.00(cy), 1(mn) CFSTI
9791	19-30374	Dep.(mn); $2.00(cy), 1(mn) CFSTI
9817	19-31598	Dep.(mn); $2.00(cy), 1(mn) CFSTI
9897	19-31599	Dep.(mn); $3.00(cy), 2(mn) CFSTI
10695	19-31600	Dep.(mn); $1.00(cy), 1(mn) CFSTI
10918	19-31193	Dep.(mn); $3.00(cy), 2(mn) CFSTI
10992	19-30375	Dep.(mn); $2.00(cy), 1(mn) CFSTI
NASA-CR–	**(Misc.)**	
246	19-30740	$3.00(CFSTI)
54144	19-30691	See N64-28460
54240	19-30397	$7.00(CFSTI)
54247	19-30487	
54332	19-30670	
54339	19-31601	
NASA-TMX–	**(Non-AEC)**	
51667	19-30943	See N64-20594
NASA-TN–	**(Misc.)**	
D-2860	19-30376	$2.00(CFSTI)
NASA-TT–	**(Non-AEC)**	
F-145	19-31137	CFSTI
NBL–		
216	19-30081	Dep.; $4.00(cy), 3(mn) CFSTI
NBS–	**(Misc.)**	
8797	19-31331	Dep.(mn); $1.00(cy), 1(mn) CFSTI
NC–	**(Norwegian)**	
65	19-31554	See TID-21793
NEVIS–	**(Misc.)**	
134	19-31004	See CU-1932-240
NIJS-R–	**(Yugoslavian)**	
429	19-31225	Dep.(mn)
433	19-30944	Dep.(mn)
NLCO–		
923	19-30692	Dep.(mn); $1.00(cy), 1(mn) CFSTI
NMI–	**(Misc.)**	
2138	19-30694	See NYO-2784-9
2139	19-30695	See NYO-2784-10
NP–	**(AEC File No. for Non-AEC Reports)**	
14504	19-31511	J. Nucl. Sci. Technol. (Tokyo), 2: 149-59(1965)
14894	19-31548	Dep.(mn)
14897	19-31549	Dep.(mn)
14904	19-30402	Dep.(mn)
14947	19-31446	
14969	19-30082	Dep.(mn)
14972	19-30524	Dep.(mn)
14990	19-31134	
15018	19-31226	Dep.(mn)
15021	19-31009	Dep.(mn)
15026	19-31227	Dep.(mn)
15045	19-30741	Free(NBS, Washington, D. C.)
15046	19-31194	
15054	19-30232	Dep.
15064	19-30440	
15066	19-30441	Dep.(mn)
NPA-Int.–	**(Non-AEC)**	
63/11	19-31010	Dep.(mn)
NUMEC–		
3432-9	19-30693	Dep.(mn); $1.00(cy), 1(mn) CFSTI
NYO–		
901-33	19-29900	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1807-10	19-31228	Dep.(mn); $1.00(cy), 1(mn) CFSTI
2784-9	19-30694	Dep.(mn); $2.00(cy), 1(mn) CFSTI
2784-10	19-30695	Dep.(mn); $1.00(cy), 1(mn) CFSTI
3029-2	19-31634	Dep.(mn); $1.00(cy), 1(mn) CFSTI
3087-2	19-31634	See NYO-3029-2
3087-4	19-30742	Dep.(mn); $1.00(cy), 1(mn) CFSTI
3289-1	19-31550	Dep.(mn); $3.00(cy), 2(mn) CFSTI
3421-3	19-30525	Dep.(mn); $2.00(cy), 1(mn) CFSTI
3454-1	19-30743	Dep.(mn); $4.00(cy), 3(mn) CFSTI
ORNL–		
3527	19-30322	Dep.(mn); $6.00(cy), 5(mn) CFSTI
3789	19-30066	Dep.; $7.00(cy), 6(mn) CFSTI
3790	19-30674	Dep.; $4.00(cy), 3(mn) CFSTI
3815	19-30632	Dep.(mn); $2.00(cy), 1(mn) CFSTI
ORNL-P–	**(Misc.)**	
21	19-31208	Health Phys., 11: 519-22(1965)
104	19-29959	Mutation Res., 1: 337-43(1964)
108	19-31261	J. Phys. Chem. Solids, 26: 883-94(1965)
300	19-30546	Health Phys., 11: 549-52(1965)
524	19-30263	J. Chem. Phys., 43: 483-91(1965)
577	19-29961	Nature, 206: 905-8(1965)
724	19-30306	Intern. J. Appl. Radiation Isotopes, 16: 319-25(1965)
838	19-30307	Intern. J. Appl. Radiation Isotopes, 16: 332-4(1965)
936	19-30809	Trans. Met. Soc. AIME, 233: 1138-45(1965)
976	19-30167	Inorg. Chem., 4: 881-6(1965)
1047	19-30112	J. Chem. Phys., 43: 751-5(1965)
1067	19-31229	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1082	19-31230	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1088	19-31231	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1089	19-30526	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1110	19-30527	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1145	19-30882	Dep.(mn); $1.00(cy), 1(mn) CFSTI IEEE (Inst. Elec. Electron. Engrs.), Trans. Nucl. Sci., NS-12: No. 3, 718-20(1965)
1167	19-31195	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1237	19-30083	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1240	19-31447	Dep.(mn); $3.00(cy), 2(mn) CFSTI
1243	19-30350	Nucl. Struct. Eng., 1: 449-56(1965)
ORNL-TM–		
733	19-31610	Dep.(mn); $1.00(cy), 1(mn) CFSTI
909	19-31611	Dep.(mn); $3.00(cy), 2(mn) CFSTI
1080	19-30745	Dep.(mn); $3.00(cy), 2(mn) CFSTI
1081	19-31617	Dep.(mn); $5.00(cy), 4(mn) CFSTI
1095	19-31586	Dep.(mn); $2.00(cy), 2(mn) CFSTI
1101	19-30377	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1117	19-31232	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1124	19-30746	Dep.(mn); $3.00(cy), 2(mn) CFSTI
1129	19-30155	Dep.(mn); $5.00(cy), 3(mn) CFSTI
1136	19-30442	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1139	19-30324	Dep.(mn); $2.00(cy), 2(mn) CFSTI
1141	19-31520	Dep.(mn); $3.00(cy), 2(mn) CFSTI
1146	19-30652	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1154	19-30395	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1162	19-31635	Dep.(mn); $1.00(cy), 1(mn) CFSTI
ORNL-tr–		
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